SERIES
682XXB/683XXB
SYNTHESIZED SIGNAL GENERATORS

GPIB PROGRAMMING MANUAL

Anritsu

490 JARVIS DRIVE
MORGAN HILL, CA 95037-2809

P/N: 10370-10286
REVISION: F
PRINTED: AUGUST 1999
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MANUAL CHANGES

MANUAL:
Title: Series 682XXB/683XXB Synthesized Signal Generator GPIB Programming Manual
Part Number: 10370-10286
Rev. Ltr/Date: F / August 1999

CHANGE PACKET
Part Number: 10900-00313

INSTRUCTIONS

1. Make the manual changes listed below. The changes are listed in numerical order by page number. Effectivity is all 682XXB models with Firmware Version 2.45 and above, 682X5B models with Firmware Version 1.34 and above, 683XXB models with Firmware Version 2.56 and above, and 683X5B models with Firmware Version 1.38 and above.
2. The replacement pages provided are for technical changes to the manual. The black bar or bars in the replacement page margins shows the area in which the changes were made.

CHANGE 1, February 2000

1. **Page 2-5**
   Replace with enclosed pages 2-5 and 2-6, Changed: February 2000.

2. **Pages 2-52 and 2-53**
   Replace with enclosed pages 2-51 thru 2-54, Changed: February 2000.

3. **Page A-12**
   Replace with enclosed pages A-11 thru A-15/A-16, Changed: February 2000.

PCO: MI001654

Table 2-1. 682XXB/683XXB GPIB Command Codes Listed by Function (2 of 3)

GPIB Command Group Function	Command Codes	Para.	Page
Measure Function Commands	AMI, FMD, MOM, PM1, PM0	2-10	2-39
Output Commands	*IDN?, OI, OFL, OFH, OF0, OF1, OF2, OF3, OF4, OF5, OF6, OF7, OF8, OF9, OM0, OM1, OM2, OM3, OM4, OM5, OM6, OM7, OM8, OM9, OL0, OL1, OL2, OL3, OL4, OL5, OL6, OL7, OL8, OL9, OLO, ODF, OPD, OPS, OSD, OSS, OST, OAD1, OAD2, OAR, OAW, OAS, OAB, OAI, OAE, OFD, OFR, OFW, OFK, OFS, OFI, OFE, OPR, OPP, OPW, OW1, OW2, OW3, OW4, ODP, OD1, OD2, OD3, OD4, ODD, ODE, ODL, ODS, OMD, OPC, OPT, OP5, OP3, OMM, OPHD, OPHR, OPHW, OPHM, OPHS, OPHI, OPHE, OPM, OVN, OWT, OSE, OEM, OES, OSB,OSM, OSR	2-11	2-40
Stored Setup Commands	SAF, SAM, SM, SSN(M_{1-9}), RCF, RCM, RSN(M_{1-9})	2-12	2-45
Service Request and Status Byte Commands	ES1, ES0, FB1, FB0, LE1, LE0, MB0, MB1, MB2, PE1, PE0, SB1, SB0, SE1, SE0, SQ1, SQ0, UL1, UL0, LS1, LS0, EL1, EL0, II1, II0, CSB	2-13	2-47
Configuration Commands	BPN, BPP, EP0, EP1, FRS, PPO, PPC, RC0, RC1, RT0, RT1, RO0, RO1, RR0, RR1, TR0, TR1	2-14	2-52
Group Execute Trigger (GET) Commands	GTC, GTD, GTF, GTL, GTO, GTS, GTT, GTU, Y	2-15	2-54
Fast-Frequency-Switching Commands	ZL($X_{000-999}$), ZEL, ZS($X_{000-999}$)	2-16	2-55
Power-Offset-Table Commands	PT0, PT1, PTC, PTL	2-17	2-56
User Level Calibration Commands	LU0, LU1, LU2, LU3, LU4, LU5, LUS, LUR	2-18	2-59
Master-Slave Operation Commands	S0, S1	2-19	2-67

Table 2-1. 682XXB/683XXB GPIB Command Codes Listed by Function (3 of 3)

GPIB Command Group Function	Command Codes	Para.	Page
Self Test Command	TST	2-20	2-68
Miscellaneous Commands	ADD, CS0, CS1, DS0, DS1, RL, RST, SNR	2-21	2-70

2-3 DATA INPUT RESTRICTIONS

The 682XXB/683XXB signal generator does ***not*** accept parameter or data entries in an exponential or scientific notation format. The accepted data formats are as follows:

- A decimal or integer format for entering parameters and data.
- A binary-byte format for entering the status byte mask commands (paragraph 2-13), the RCF and RCM stored-setup commands (paragraph 2-12), the power-offset-table commands (paragraph 2-17), and the LUR user level calibration command (paragraph 2-18).

Programming Note: The signal generator only recognizes the following 65 characters:

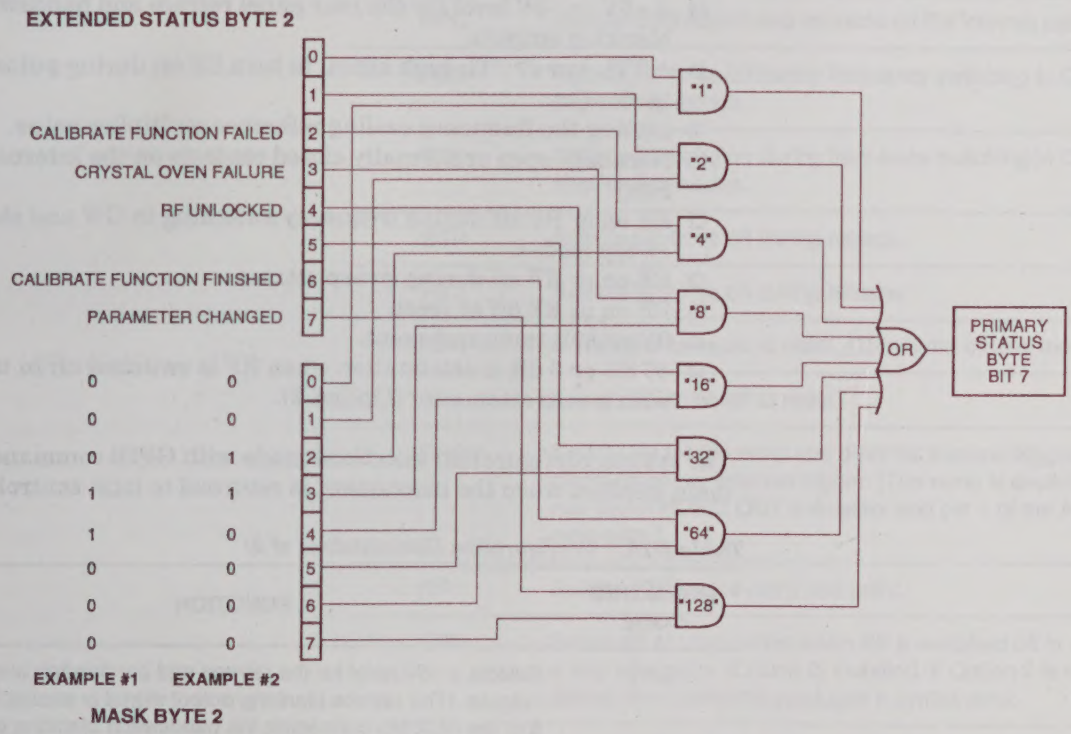
- The 52 upper- and lower-case alphabetic characters. (The 682XXB/683XXB accepts both upper- and lower-case characters without distinguishing between the cases).
- The minus sign (–).
- The comma (,).
- The decimal point (.).
- The numerals between 0 and 9.

All characters other than the 65 listed above are ignored and can be interspersed between meaningful characters without ill effect. This use of other characters can improve readability. For example, the two command strings below are valid and interchangable.

```
"F12.754GHF27.792GHSF1SWPMK0L12DM"

"F1=2.754 GH, F2=7.792 GH, SF1, SWP, MK0, L1=2 DM"
```

The 682XXB/683XXB has a software mask that permits manipulation of the three status bytes over the bus. This manipulation is accomplished by sending the command codes MB0, MB1, MB2, or all three at once, followed by an argument that assigns an on/off condition for each bit in the byte. Two examples are shown below:



EXAMPLE #1: `"MB2" (CHR $(24))`

Sets bits 3 and 4 in Mask Byte 2 to 1 and all other bits to 0, thus enabling bits 3 and 4 in Extended Status Byte 2 to be read from the bit 7 position of the Primary Status Byte.

EXAMPLE #2: `"MB2" (CHR $(12))`

Sets bits 2 and 3 in Mask Byte 2 to 1 and all other bits to 0, thus enabling bits 2 and 3 in Extended Status Byte 2 to be read from the bit 7 position of the Primary Status Byte.

Figure 2-12. *Status Byte Mask Programming Examples*

2-14 CONFIGURATION COMMANDS

Table 2-14 lists the configuration command mnemonic codes. These commands permit selection/setting of the following system configuration items via the bus:

- A +5V or –5V level for the rear panel retrace and bandswitch blanking outputs.
- A TTL-low or TTL-high signal to turn RF on during pulse moduation.
- Setting the frequency scaling reference multiplier value.
- Normally-open or normally-closed contacts on the internal penlift relay.
- RF on or RF off during frequency switching in CW and step sweep modes.
- RF on or RF off during sweep retrace.
- RF on or RF off at reset.
- 0V or 10V ramp rest point.
- 40 dB or 0 dB of attenuation when RF is switched off in units with a step attenuator (Option 2).

The system configuration selections made with GPIB commands remain in effect when the instrument is returned to local control.

Table 2-14. Configuration Commands (1 of 2)

MNEMONIC CODE	FUNCTION
BPN	Selects a –5V level for the retrace and bandswitch blanking outputs. (The retrace blanking output signal is available at pin 6 of the AUX I/O connector; the bandswitch blanking output signal at pin 20 of the AUX I/O connector.)
BPP	Selects a +5V level for the retrace and bandswitch blanking outputs.
EP0	Selects TTL-low to turn RF on during pulse modulation.
EP1	Selects TTL-high to turn RF on during pulse modulation.
FRS	Permits setting the frequency scaling reference multiplier value. The multiplier value must be between 0.1 to 14 and must be terminated with TMS. ***Programming Example:*** Programming "**FRS 3 TMS**" sets the frequency scaling reference multiplier to 3. This command affects all entered and displayed frequencies, but does not affect the output of the instrument.
PPO	Selects normally-open contacts on the internal penlift relay. (The penlift relay output, optionally available at the rear panel, is used to lift a plotter pen during retrace.)

Table 2-14. Configuration Commands (2 of 2)

MNEMONIC CODE	FUNCTION
PPC	Selects normally-closed contacts on the internal penlift relay.
RC0	Selects RF to be off during frequency switching in CW and step sweep modes.
RC1	Selects RF to be on during frequency switching in CW and step sweep modes.
RT0	Selects RF to be off during retrace.
RT1	Selects RF to be on during retrace.
RO0	Selects RF to be on at reset. (This is the default mode.)
RO1	Selects RF to be off at reset.
RR0	Selects 0V for the ramp rest point for sweeps triggered by a single trigger or external trigger. (The ramp is available at the rear panel HORIZ OUT connector and pin 1 of the AUX I/O connector.)
RR1	Selects 10V for the ramp rest point.
TR0	Sets 0 dB of attenuation when RF is switched off in units with a step attenuator (Option 2) installed. If Option 2 is not installed, this command produces a syntax error.
TR1	Sets 40 dB (minimum) of attenuation when RF is switched off in units with a step attenuator (Option 2) installed. This provides a better output source match. If Option 2 is not installed, this command produces a syntax error.

2-15 GROUP EXECUTE TRIGGER COMMANDS

Table 2-15 lists the group execute trigger (GET) command mnemonic codes. These commands let a GET bus message (Table 1-3) be used to trigger certain signal generator functions and thus speed up bus operations.

In the default state, the 682XXB/683XXB responds to a GET message by triggering a single sweep.

Table 2-15. *Group Execute Trigger Commands*

MNEMONIC CODE	FUNCTION
GTC	Configures the 682XXB/683XXB to execute a SQF command (scan to the next higher preset CW frequency) each time a GET message is received.
GTD	Configures the 682XXB/683XXB to execute a DN command (steps the open parameter down by the step size) each time a GET message is received.
GTF	Configures the 682XXB/683XXB to execute a fast-frequency-switching step (Table 2-16) each time a GET message is received.
GTL	Configures the 682XXB/683XXB to execute a TSS command (steps to the next point in a dual step sweep mode) each time a GET message is received.
GTO	Disables the GET functions.
GTS	Configures the 682XXB/683XXB to execute a TRS command (trigger a single sweep) each time a GET message is received. This is the default mode.
GTT	Configures the 682XXB/683XXB to execute a TST command (execute a complete signal generator self test) each time a GET message is received.
GTU	Configures the 682XXB/683XXB to execute a UP command (steps the open parameter up by the step size) each time a GET message is received.
Y	Sending a "Y" is equivalent to sending a GET.

GPIB Commands (11 of 15)

Command Code	Function	Page Number
PCT	Percent (%) data terminator	2-14
PCV	Percent per volt (%/V) data terminator	2-14
PDT	Opens the power sweep dwell time parameter	2-9
PDY	Opens the internal pulse delay1 parameter (Same as D1)	2-11
PE0	Inhibits Parameter Range Error SRQ generation	2-49
PE1	Enables Parameter Range Error SRQ generation	2-49
PER	Opens the internal pulse period parameter	2-11
PH0	Turns off the internal or external ΦM function	2-35
PH1	Turns on the external ΦM function in Narrow mode	2-35
PH2	Turns on the external ΦM function in Wide mode	2-35
PH3	Selects front panel external ΦM input	2-35
PH4	Selects rear panel external ΦM input	2-35
PH5	Selects external ΦM input impedance of 50Ω	2-35
PH6	Selects external ΦM input impedance of 600Ω	2-36
PH7	Turns on the internal ΦM function in Narrow mode	2-36
PH8	Turns on the internal ΦM function in Wide mode	2-36
PHD	Opens the internal ΦM deviation parameter	2-10
PHN	Turns on the external ΦM function in Narrow mode (Same as PH1)	2-36
PHR	Opens the internal ΦM rate parameter	2-10
PHS	Opens the external ΦM sensitivity parameter	2-10
PHV(x)	Selects the internal FM waveform, where x = 1-sine wave, 2-square wave, 3-positive ramp, 4-negative ramp, 5-Guassian noise, 6-uniform noise, 7-triangle wave	2-36
PHW	Turns on the external FM function in Wide mode (Same as PH2)	2-36
PL1	Selects external power meter leveling of the output power	2-26
PM0	Turns off the internal power meter measurement mode	2-39
PM1	Turns on the internal power meter measurement mode	2-39
PMD(x)	Selects the internal pulse mode, where x = 1-single, 2-doublet, 3-triplet, 4-quadruplet	2-37
PNS	Opens the power sweep number of steps parameter	2-9
PPO	Selects normally-open contacts on the pen lift relay	2-52
PPC	Selects normally-closed contacts on the pen lift relay	2-52
PR	Opens the internal pulse frequency parameter	2-11
PT0	Disables the Power Offset Table	2-56
PT1	Enables the Power Offset Table	2-56
PTC	Changes a Power Offset Table entry	2-56

GPIB Commands (12 of 15)

Command Code	Function	Page Number
PTF	Selects internal pulse triggering on the falling edge of an external input. Active only when pulse trigger is gated, triggered, or triggered with delay.	2-37
PTG(x)	Selects the internal pulse trigger, where x = 1-free run, 2-gated, 3-delayed, 4-triggered, 5-triggered with delay, 6-composite	2-37
PTL	Loads a Power Offset Table	2-56
PTR	Selects internal pulse triggering on the rising edge of an external input. Active only when pulse trigger is gated, triggered, or triggered with delay.	2-37
PVT	Opens the ALC power slope pivot point frequency parameter	2-12
PW	Opens the internal pulse width1 parameter (Same as W1)	2-11
RO0	Selects RF to be on at reset.	2-52
RO1	Selects RF to be off at reset.	2-52
RC0	Selects RF off during frequency switching in CW or step sweep modes	2-52
RC1	Selects RF on during frequency switching in CW or step sweep modes	2-52
RCF	Readies the 682XXB/683XXB to receive a new instrument setup from the controller	2-46
RCM	Readies the 682XXB/683XXB to receive a new instrument setup and new stored setups from the controller	2-46
RD	Radians data terminator	2-14
RF0	Turns off the RF output	2-25
RF1	Turns on the RF output	2-25
RL	Returns the instrument to local control	2-70
RR0	Selects 0V for the ramp rest point	2-52
RR1	Selects 10V for the ramp rest point	2-52
RSN(M_{1-9})	Recalls an instrument setup stored in internal setup memory location M, where M = 1 to 9.	2-46
RSS	Reset a sweep if in progress	2-19
RST	Resets the instrument to its default settings	2-70
RT0	Selects RF to be off during retrace	2-52
RT1	Selects RF to be on during retrace	2-52
RV	Radians per volt data terminator	2-14
S0	Turns off the Master-Slave mode of operation	2-67
S1	Turns on the Master-Slave mode of operation	2-67
SAF	Outputs the current instrument setup to the controller	2-46
SAM	Outputs the current instrument setup and all stored setups to the controller	2-46
SB0	Inhibits Extended Status Byte 2 SRQ generation	2-49

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Command Code	Function	Page Number
SB1	Enables Extended Status Byte 2 SRQ generation	2-49
SC0	Turns SCAN modulation function on	2-38
SC1	Turns SCAN modulation function off	2-38
SD0	Turns off the internal pulse stepped delay mode	2-37
SD1	Turns on the internal pulse stepped delay mode	2-37
SDD	Opens the internal pulse stepped delay mode step size parameter	2-11
SDE	Opens the internal pulse stepped delay mode delay 1 stop parameter	2-11
SDL	Opens the internal pulse stepped delay mode dwell-time-per-step parameter	2-12
SDS	Opens the internal pulse stepped delay mode delay 1 start parameter	2-12
SDT	Opens the step sweep dwell time parameter	2-9
SE0	Inhibits Syntax Error SRQ generation	2-50
SE1	Enables Syntax Error SRQ generation	2-49
SEC	Seconds data terminator	2-14
SF1	Selects the F1-F2 sweep mode	2-19
SF3	Selects the F3-F4 sweep mode	2-19
SLDF	Opens the ΔF parameter of the Slave unit	2-9
SLF0	Opens the F0 parameter of the Slave unit	2-8
SLF1	Opens the F1 parameter of the Slave unit	2-8
SLF2	Opens the F2 parameter of the Slave unit	2-8
SLF3	Opens the F3 parameter of the Slave unit	2-8
SLF4	Opens the F4 parameter of the Slave unit	2-8
SLF5	Opens the F5 parameter of the Slave unit	2-8
SLF6	Opens the F6 parameter of the Slave unit	2-8
SLF7	Opens the F7 parameter of the Slave unit	2-8
SLF8	Opens the F8 parameter of the Slave unit	2-8
SLF9	Opens the F9 parameter of the Slave unit	2-8
SLL1	Opens the main power level parameter (L1) for the Slave unit	2-12
SLL2	Opens the alternate sweep power level parameter (L2) for the Slave unit	2-12
SLM0	Opens the M0 parameter of the Slave unit	2-9
SLM1	Opens the M1 parameter of the Slave unit	2-9
SLM2	Opens the M2 parameter of the Slave unit	2-9
SLM3	Opens the M3 parameter of the Slave unit	2-9
SLM4	Opens the M4 parameter of the Slave unit	2-9
SLM5	Opens the M5 parameter of the Slave unit	2-9

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Command Code	Function	Page Number
SLM6	Opens the M6 parameter of the Slave unit	2-9
SLM7	Opens the M7 parameter of the Slave unit	2-9
SLM8	Opens the M8 parameter of the Slave unit	2-9
SLM9	Opens the M9 parameter of the Slave unit	2-9
SLP	Opens the ALC power slope value parameter	2-12
SL0	Turns off the ALC power slope function	2-26
SL1	Turns on the ALC power slope function	2-26
SLV	Opens the power level parameter for the Slave unit (Same as SLL1)	2-12
SM	Recalls the next stored instrument setup in sequence	2-46
SNR	Enter the instrument serial number (SNRnnnnnnX)	2-70
SNS	Opens the step sweep number of steps parameter	2-9
SOF	Opens the frequency offset parameter for the Slave unit	2-12
SPS	Steps data terminator	2-14
SP0	Deselects non-equally spaced step sweep	2-19
SP1	Selects non-equally spaced step sweep	2-19
SQ0	Disables the SRQ generation function	2-50
SQ1	Enables the SRQ generation function	2-50
SQD	Scan down to next lower preset CW frequency	2-16
SQF	Scan to next higher preset CW frequency	2-16
SQP	Turns on internal 1 kHz square wave pulse modulation	2-37
SQU	Scan up to next higher preset CW frequency	2-16
SSN(M_{1-9})	Saves the current instrument setup in internal setup memory location M, where M = 1 to 9	2-46
SSP	Selects step sweep	2-19
SW0	Turns off the internal or external pulse modulation function (Same as P0)	2-38
SW1	Turns on internal 400 Hz square wave pulse modulation	2-38
SW2	Turns on internal 1 kHz square wave pulse modulation (Same as SQP)	2-38
SW3	Turns on internal 7.8125 kHz square wave pulse modulation	2-38
SW4	Turns on internal 27.8 kHz square wave pulse modulation	2-38
SW5	Selects front panel external pulse input (Same as P3)	2-38
SW6	Selects rear panel external pulse input (Same as P4)	2-38
SWP	Selects analog sweep	2-19
SWT	Opens the analog sweep and CW ramp time parameter	2-9
SYZ	Opens the increment/decrement step size parameter	2-15
TMS	Times terminator	2-14

GPIB Commands (15 of 15)

Command Code	Function	Page Number
TR0	Sets 0 dB of attenuation when RF is switched off in units with a step attenuator (Option 2) installed.	2-52
TR1	Sets 40 dB (minimum) of attenuation when RF is switched off in units with a step attenuator (Option 2) installed.	2-52
TRG	Triggers a single sweep	2-19
TRS	Triggers a single sweep (Same as TRG)	2-19
TSS	Advances sweep to next step in dual step sweep mode	2-19
TST	Starts an instrument self-test	2-68
UL0	Inhibits RF Unleveled SRQ generation	2-50
UL1	Enables RF Unleveled SRQ generation	2-50
UP	Increment the open parameter by step size	2-12
US	Microseconds (µs) data terminator	2-14
VM1	Turns on the Video marker mode	2-23
W1	Opens the internal pulse width1 parameter	2-11
W2	Opens the internal pulse width2 parameter	2-11
W3	Opens the internal pulse width3 parameter	2-11
W4	Opens the internal pulse width4 parameter	2-11
XL0	Opens the L0 parameter	2-8
XL1	Opens the L1 parameter	2-8
XL2	Opens the L2 parameter	2-8
XL3	Opens the L3 parameter	2-8
XL4	Opens the L4 parameter	2-8
XL5	Opens the L5 parameter	2-8
XL6	Opens the L6 parameter	2-8
XL7	Opens the L7 parameter	2-8
XL8	Opens the L8 parameter	2-8
XL9	Opens the L9 parameter	2-8
XP	Turns on the external pulse modulation function	2-36
Y	Equivalent to a Group Excute Trigger (GET)	2-54
ZL($X_{000\text{-}999}$)	Loads a CW frequency into the stack at location X (fast-frequency-switching mode)	2-55
ZEL	Ends frequency loading (fast-frequency-switching mode)	2-55
ZS($X_{000\text{-}999}$)	Sets the stack pointer to point to location X (fast-frequency-switching mode)	2-55

DECLARATION OF CONFORMITY

Manufacturer's Name: ANRITSU COMPANY

Manufacturer's Address: Microwave Measurements Division
490 Jarvis Drive
Morgan Hill, CA 95037-2809
USA

declares that the product specified below:

Product Name: Synthesized CW / Sweep / Signal Generator

Model Number: 680XXB, 681XXB, 682XXB, 683XXB

conforms to the requirement of:

EMC Directive 89/336/EEC as amended by Council Directive 92/31/EEC & 93/68/EEC
Low Voltage Directive 73/23/EEC as amended by Council directive 93/68/EEC

Electromagnetic Interference:

Emissions: CISPR 11:1990/EN55011:1991 Group 1 Class A

Immunity: IEC 1000-4-2:1995/prEN50082-1:1995 - 4kV CD, 8kV AD
IEC 1000-4-3:1993/ENV50140:1994 - 3V/m
IEC 1000-4-4:1995/prEN50082-1:1995 - 0.5kV SL, 1kV PL
IEC 1000-4-5:1995/prEN50082-1:1995 - 0.5kV - 1kV LN
0.5kV - 1kV NG
0.5kV - 1kV GL

Electrical Safety Requirement:

Product Safety: IEC 1010-1:1990 + A1/EN61010-1:1993

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5-SEPT-97
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A-1 INTRODUCTION A-1

Chapter 1
General GPIB Information

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Chapter 1
General GPIB Information

1-1 SCOPE OF MANUAL

This manual provides information for remote operation of the Series 682XXB/683XXB Synthesized Signal Generators using commands sent from an external controller via the IEEE-488 General Purpose Interface Bus (GPIB). It includes the following:

- A general description of the GPIB and the bus data transfer and control functions.
- A listing of the IEEE-488 Interface Function Messages recognized by the signal generator with a description of its response.
- A complete listing and description of all 682XXB/683XXB GPIB commands (i.e., Product Specific Commands) that can be used to control signal generator operation with programming examples.

This manual is intended to be used in conjunction with the Series 682XXB/683XXB Synthesized Signal Generators Operation Manual, P/N 10370-10284. Refer to that manual for general information about the 682XXB/683XXB, including equipment set up and front panel (manual mode) operating instructions.

Electronic Manual

This manual is available on CD ROM as an Adobe Acrobat Portable Document Format (*.pdf) file. The file can be viewed using Acrobat Reader, a free program that is also included on the CD ROM. The file is "linked" such that the viewer can choose a topic to view from the displayed "bookmark" list and "jump" to the manual page on which the topic resides. The text can also be word-searched. Contact ANRITSU Customer Service for price and availability.

1-2 INTRODUCTION

This chapter provides a general description of the GPIB and the bus data transfer and control functions. It also contains a listing of the 682XXB/683XXB's GPIB interface function subset capability and response to IEEE-488 interface function messages.

The GPIB information presented in this chapter is general in nature. For complete and specific information, refer to the following documents: ANSI/IEEE Std 488.1-1987 *IEEE Standard Digital Interface for Programmable Instrumentation* and ANSI/IEEE Std 488.2-1987 *IEEE Standard Codes, Formats, Protocols and Common Commands*. These documents precisely define the total specification of the mechanical and electrical interface, and of the data transfer and control protocols.

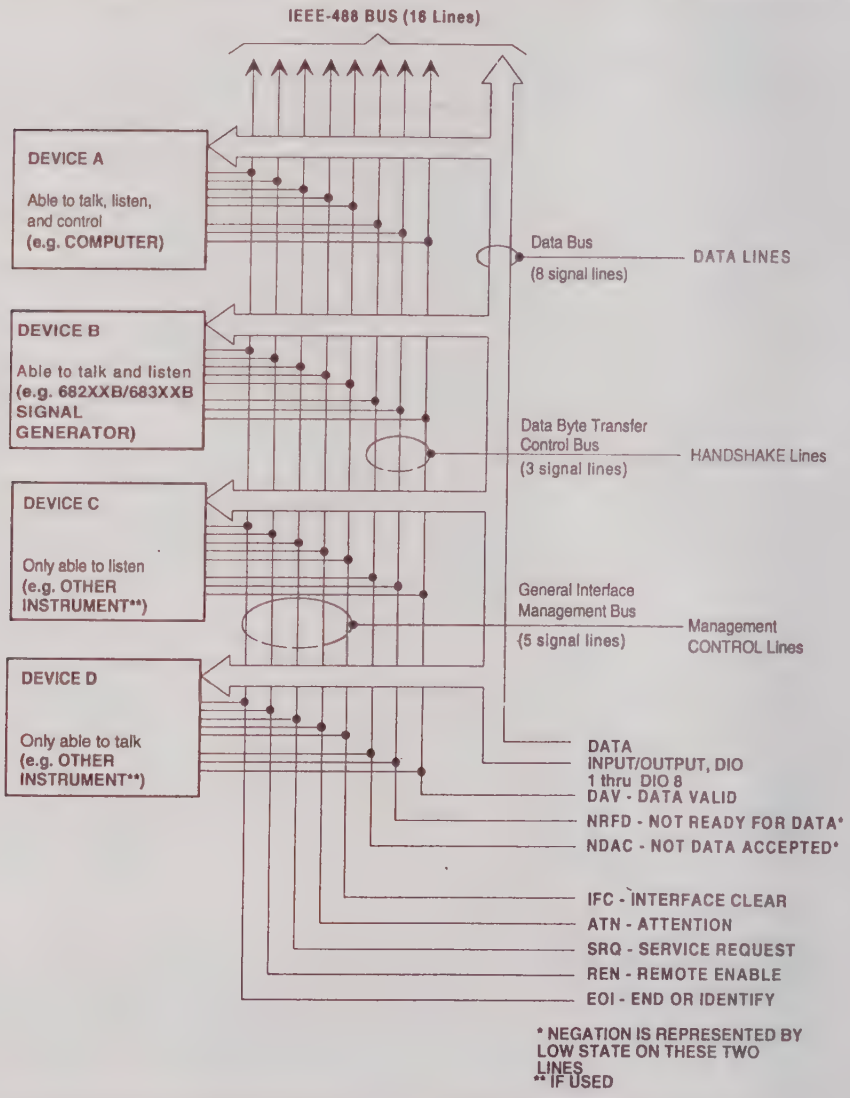

Figure 1-1. *Interface Connections and GPIB Bus Structure*

1-3 IEEE-488 INTERFACE BUS DESCRIPTION

The IEEE-488 General Purpose Interface Bus (GPIB) is an instrumentation interface for integrating instruments, computers, printers, plotters, and other measurement devices into systems. The GPIB uses 16 signal lines to effect transfer of information between all devices connected on the bus.

The following requirements and restrictions apply to the GPIB.

- No more than 15 devices can be interconnected by one contiguous bus; however, an instrumentation system may contain more than one interface bus.
- The maximum total cumulative cable length for one interface bus may not exceed twice the number of devices connected (in meters), or 20 meters—whichever is less.
- A maximum data rate of 1 Mb/s across the interface on any signal line.
- Each device on the interface bus must have a unique address, ranging from 00 to 30.

The devices on the GPIB are connected in parallel, as shown in Figure 1-1. The interface consists of 16 signal lines and 8 ground lines in a shielded cable. Eight of the signal lines are the data lines, DIO 1 thru DIO 8. These data lines carry messages (data and commands), one byte at a time, among the GPIB devices. Three of the remaining lines are the handshake lines that control the transfer of message bytes between devices. The five remaining signal lines are referred to as interface management lines.

The following paragraphs provide an overview of the GPIB including a description of the functional elements, bus structure, bus data transfer process, interface management bus, device interface function requirements, and message types.

Functional Elements

Effective communications between devices on the GPIB requires three functional elements; a *talker*, a *listener*, and a *controller*. Each device on the GPIB is categorized as one of these elements depending on its current interface function and capabilities.

Talker

A talker is a device capable of sending device-dependent data to another device on the bus when addressed to talk. Only one GPIB device at a time can be an active talker.

Listener

A listener is a device capable of receiving device-dependent data from another device on the bus when addressed to listen. Any number of GPIB devices can be listeners simultaneously.

Controller

A controller is a device, usually a computer, capable of managing the operation of the GPIB. Only one GPIB device at a time can be an active controller. The active controller manages the transfer of device-dependent data between GPIB devices by designating who will talk and who will listen.

System Controller

The system controller is the device that always retains ultimate control of the GPIB. When the system is first powered-up, the system controller is the active controller and manages the GPIB. The system controller can pass control to a device, making it the new active controller. The new active controller, in turn, may pass control on to yet another device. Even if it is not the active controller, the system controller maintains control of the Interface Clear (IFC) and Remote Enable (REN) interface management lines and can thus take control of the GPIB at anytime.

Bus Structure

The GPIB uses 16 signal lines to carry data and commands between the devices connected to the bus. The interface signal lines are organized into three functional groups.

- Data Bus (8 lines)
- Data Byte Transfer Control Bus (3 lines)
- General Interface Management Bus (5 lines)

The signal lines in each of the three groups are designated according to function. Table 1-1 lists these designations.

Table 1-1. Interface Bus Signal Line Designations

Bus Type	Signal Line Name	Function
Data Bus	DIO1–DIO8	Data Input/Output, 1 thru 8
Data Byte Transfer Control Bus	DAV	Data Available
	NRFD	Not Ready For Data
	NDAC	Not Data Accepted
General Interface Management Bus	ATN	Attention
	IFC	Interface Clear
	SRQ	Service Request
	REN	Remote Enable
	EOI	End Or Identify

Data Bus Description

The data bus is the conduit for the transfer of data and commands between the devices on the GPIB. It contains eight bi-directional, active-low signal lines —DIO 1 thru DIO 8. Data and commands are transferred over the data bus in byte-serial, bit-parallel form. This means that one byte of data (eight bits) is transferred over the bus at a time. DIO 1 represents the least-significant bit (LSB) in this byte and DIO 8 represents the most-significant bit (MSB). Bytes of data are normally formatted in seven-bit ASCII (American Standard Code for Information Interchange) code. The eighth (parity) bit is not used.

Each byte placed on the data bus represents either a command or a data byte. If the Attention (ATN) interface management line is TRUE while the data is transferred, then the data bus is carrying a bus command which is to be received by every GPIB device. If ATN is FALSE, then a data byte is being transferred and only the active listeners will receive that byte.

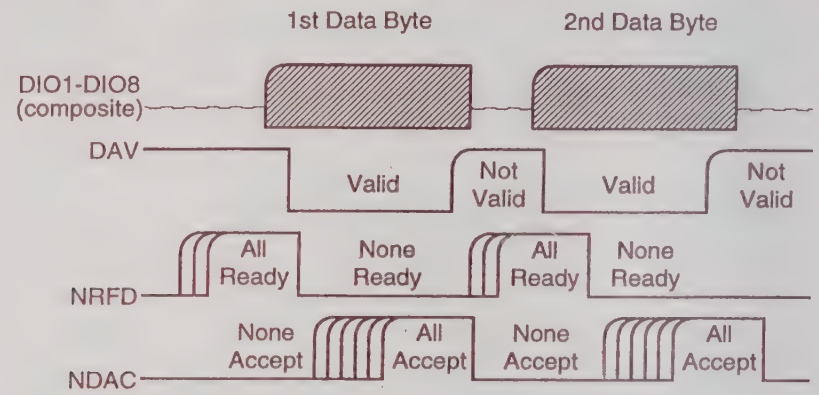

Figure 1-2. Typical GPIB Handshake Operation

Data Byte Transfer Control Bus Description

Control of the transfer of each byte of data on the data bus is accomplished by a technique called the "three-wire handshake", which involves the three signal lines of the Data Byte Transfer Control Bus. This technique forces data transfers at the speed of the slowest listener, which ensures data integrity in multiple listener transfers. One line (DAV) is controlled by the talker, while the other two (NRFD and NDAC) are wired-OR lines shared by all active listeners. The handshake lines, like the other GPIB lines, are active low. The technique is described briefly in the following paragraphs and is depicted in Figure 1-2. For further information, refer to ANSI/IEEE Std 488.1.

DAV (Data Valid)

This line is controlled by the active talker. Before sending any data, the talker verifies that NDAC is TRUE (active low) which indicates that all listeners have accepted the previous data byte. The talker then places a byte on the data lines and waits until NRFD is FALSE (high) which indicates that all addressed listeners are ready to accept the information. When both NRFD and NDAC are in the proper state, the talker sets the DAV line TRUE (active low) to indicate that the data on the bus is valid (stable).

NRFD (Not Ready For Data)

This line is used by the listeners to inform the talker when they are ready to accept new data. The talker must wait for each listener to set the NRFD

line FALSE (high) which they will do at their own rate. This assures that all devices that are to accept the data are ready to receive it.

NDAC (Not Data Accepted)
This line is also controlled by the listeners and is used to inform the talker that each device addressed to listen has accepted the data. Each device releases NDAC at its own rate, but NDAC will not go FALSE (high) until the slowest listener has accepted the data byte.

General Interface Management Bus Description

The general interface management bus is a group of five signal lines used to manage the flow of information across the GPIB. A description of the function of each of the individual control lines is provided below.

ATN (Attention)
The active controller uses the ATN line to define whether the information on the data bus is a command or is data. When ATN is TRUE (low), the bus is in the command mode and the data lines carry bus commands. When ATN is FALSE (high), the bus is in the data mode and the data lines carry device-dependent instructions or data.

EOI (End or Identify)
The EOI line is used to indicate the last byte of a multibyte data transfer. The talker sets the EOI line TRUE during the last data byte.

The active controller also uses the EOI line in conjunction with the ATN line to initiate a parallel poll sequence.

IFC (Interface Clear)
Only the system controller uses this line. When IFC is TRUE (low), all devices on the bus are placed in a known, quiescent state (unaddressed to talk, unaddressed to listen, and service request idle).

REN (Remote Enable)
Only the system controller uses this line. When REN is set TRUE (low), the bus is in the remote mode and devices are addressed either to listen or to talk. When the bus is in remote and a device is addressed, it receives instructions from the GPIB rather than from its front panel. When REN is set FALSE (high), the bus and all devices return to local operation.

SRQ (Service Request)
The SRQ line is set TRUE (low) by any device requesting service by the active controller.

Device Interface Function Capability

An interface function is the GPIB system element which provides the basic operational facility through which a device can receive, process, and send messages. Each specific interface function may only send or receive a limited set of messages within particular classes of messages. As a result, a set of interface functions is necessary to achieve complete communications among devices on the GPIB. ANSI/IEEE Std 488.1 defines each of the interface functions along with its specific protocol.

ANSI/IEEE Std 488.2 specifies the minimum set of IEEE 488.1 interface capabilities that each GPIB device must have. This minimum set of interface functions assures that the device is able to send and receive data, request service, and repond to a device clear message. Table 1-2 lists the interface function capability of the series 682XXB/683XXB signal generators.

Table 1-2. *682XXB/683XXB Interface Function Capability*

Function Identifier	Function	682XXB/683XXB Capability
AH1	Acceptor Handshake	Complete Capability
SH1	Source Handshake	Complete Capability
T6	Talker	No Talk Only (TON)
L4	Listener	No Listen Only (LON)
SR1	Service Request	Complete Capability
RL1	Remote/Local	Complete Capability
PP1	Parallel Poll	Complete Capability
DC1	Device Clear	Complete Capability
DT1	Device Trigger	Complete Capability
C0, C1, C2, C3, C28	Controller Capability Options	C0, No Capability; C1, System Controller; C2, Send IFC and Take Charge; C3, Send REN; C28, Send IF Messages
E2	Tri-State Drivers	Three-state bus drivers

Message Types

There are three types of information transmitted over the GPIB—interface function messages, device-specific commands, and data and instrument status messages.

Interface Function Messages

The controller manages the flow of information on the GPIB using interface function messages, usually called *commands* or *command messages*. Interface function messages perform such functions as initializing the bus, addressing and unaddressing devices, and setting device modes for remote or local operation.

There are two types of commands—multiline and uniline. Multiline commands are bytes sent by the active controller over the data bus (DIO1-DIO8) with ATN set TRUE. Uniline commands are signals carried by the individual interface management lines.

The user generally has control over these commands; however, the extent of user control depends on the implementation and varies with the specific GPIB interface hardware and software used with the external controller.

Device-Specific Commands

These commands are keywords or mnemonic codes sent by the external controller to control the setup and operation of the addressed device or instrument. The commands are normally unique to a particular instrument or class of instruments and are described in its documentation.

Device-specific commands are transmitted over the data bus of the GPIB to the device in the form of ASCII strings containing one or more keywords or codes.They are decoded by the device's *internal controller* and cause the various instrument functions to be performed.

Data and Instrument Status Messages

These messages are sent by the device to the external controller via the GPIB. They contain measurement results, instrument status, or data files that the device transmits over the data bus in response to specific requests from the external controller. The contents of these messages are instrument specific and may be in the form of ASCII strings or binary data.

In some cases data messages will be transmitted from the external controller to the device. For example, messages to load calibration data.

An SRQ (service request) is an interface function message sent *from the device* to the external controller to request service from the controller, usually due to some predetermined status condition or error. To send this message, the device sets the SRQ line of the General Interface Management Bus true, then sends a status byte on the data bus lines.

An SRQ interface function message is also sent by the device in response to a serial poll message from the controller, or upon receiving an Output Status Byte(s) command from the controller. The protocols associated with the SRQ functions are defined in the ANSI/IEEE Std 488.2 document.

The manner in which interface function messages and device-specific commands are invoked in programs is implementation specific for the GPIB interface used with the external controller. Even though both message types are represented by mnemonics, they are implemented and used in different ways.

Normally, the interface function messages are sent automatically by the GPIB driver software in response to invocation of a software function. For example, to send the IFC (Interface Clear) interface fuction message, one would call the ibsic function of the National Instruments software driver. On the other hand, the command *RST (Reset) is sent in a command string to the addressed device. In the case of the National Instruments example, this would be done by using the ibwrt function call.

1-4 682XXB/683XXB GPIB OPERATION

All Series 682XXB/683XXB Synthesized Signal Generator functions, settings, and operating modes (except for power on/standby) are controllable using commands sent from an external controller via the GPIB. When in the remote (GPIB) mode, the signal generator functions both as a listener and a talker. The GPIB interface function capability of the 682XXB/683XXB is listed in Table 1-2 (page 1-10).

Setting GPIB Operating Parameters

The 682XXB/683XXB leaves the factory with the GPIB address value set to 5 and the data delimiting terminator set to carriage return and line feed (CR/LF). A different address value can be entered from the front panel using the Configure GPIB menu. Using this same menu, the data delimiting terminator can be changed to carriage return (CR) only. Refer to Chapter 2 of the Series 682XXB/683XXB Synthesized Signal Generators Operation Manual for the procedure.

Selecting the Interface Language

Series 682XXB/683XXB Synthesized Signal Generators with Option 19 can be remotely operated using one of two external interface languages—Native or SCPI. The Native interface language uses a set of 682XXB/683XXB GPIB Product-Specific commands to control the instrument; the SCPI interface language uses a set of the Standard Commands for Programmable Instruments commands to control the unit. Selecting which of these external interface languages is to be used can be done from the front panel using the Configure GPIB menu. Refer to Chapter 2 of the Series 682XXB/683XXB Synthesized Signal Generators Operation Manual for the procedure.

Response to GPIB Interface Function Messages

Table 1-3 (page 1-14) lists the GPIB Interface Function Messages that the 682XXB/683XXB will recognize and respond to. With the exception of the Device Clear and Selected Device Clear messages, these messages affect only the operation of the 682XXB/683XXB GPIB interface. The 682XXB/683XXB response for each message is indicated.

Interface function messages are transmitted on the GPIB data lines and interface management lines as either unaddressed or addressed commands. The manner in which these messages are invoked in programs is implementation dependent. For programming information, refer to the documentation included with the GPIB Interface for the external controller used.

Table 1-3. 682XXB/683XXB Response to GPIB Interface Function Messages

Interface Function Message	Addressed Command	682XXB/683XXB Response
Device Clear (DCL) Selected Device Clear (SDC)	No Yes	Resets the 682XXB/683XXB to its default state. (Equivalent to sending the *RST command.)
Go To Local (GTL)	Yes	Returns the 682XXB/683XXB to local (front panel) control.
Group Execute Trigger (GET)	Yes	Executes a string of commands, if programmed.
Interface Clear (IFC)	No	Stops the 682XXB/683XXB GPIB interface from listening or talking. (The front panel controls are not cleared.)
Local Lockout (LLO)	No	Disables the front panel menu RETURN TO LOCAL soft-key.
Remote Enable (REN)	No	Places the 682XXB/683XXB under remote (GPIB) control when it has been addressed to listen.
Serial-Poll Enable (SPE)	No	Outputs the serial-poll status byte.
Serial-Poll Disable (SPD)	No	Disables the serial-poll function.
Parallel-Poll Configure (PPC)	Yes	Responds to a parallel-poll message (PPOLL) by setting assigned data bus line to the logical state (1,0) that indicates its correct SRQ status.
Parallel-Poll Unconfigure (PPU)	No	Disables the parallel-poll function.

Chapter 2
Programming with GPIB Commands

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Chapter 2
Programming with GPIB Commands

2-1 INTRODUCTION

This chapter provides information for remote operation of the Series 682XXB/683XXB Synthesized Signal Generators via the GPIB using 682XXB/683XXB GPIB commands. All GPIB Product-Specific commands that are accepted and implemented by the 682XXB/683XXB are listed and described by function. Sample programs showing usage of the commands are also included.

2-2 COMMAND CODES

There are over three hundred and fifty GPIB Product-Specific commands that are accepted and implemented by the 682XXB/683XXB. These GPIB commands allow the user to program all front panel and menu functions (except for power on/standby). Each GPIB command is a two- or three-character mnemonic code that represents an instrument command or parameter; for example: RST (reset).

Table 2-1, beginning on page 2-6, is a listing of all 682XXB/683XXB GPIB command mnemonic codes grouped into functional categories. The listing for each category includes references to the paragraph and page number in this chapter where a complete description of that group of commands can be found.

NOTE

A quick way to determine the function of any of the GPIB command codes listed in Table 2-1 is to look up the command code of interest in Appendix A of this manual. Appendix A is an alphabetical index of all 682XXB/683XXB GPIB command mnemonic codes. A brief description of the function of each command is also included.

GPIB Command Group Function	Command Codes	Para.	Page
Parameter Entry Commands	F0, F1, F2, F3, F4, F5, F6, F7, F8, F9, M0, M1, M2, M3, M4, M5, M6, M7, M8, M9, XL0, XL1, XL2, XL3, XL4, XL5, XL6, XL7, XL8, XL9, DLF, DFF, DFM, SLF0, SLF1, SLF2, SLF3, SLF4, SLF5, SLF6, SLF7, SLF8, SLF9, SLM0, SLM1, SLM2, SLM3, SLM4, SLM5, SLM6, SLM7, SLM8, SLM9, SLDF, SDT, SNS, SWT, LOS, PDT, PNS, ADP1, ADP2, AMR, AMS, ASD, FDV, FMR, FMS, PHD, PHR, PHS, PER, PR, PW, W1, W2, W3, W4, PDY, D1, D2, D3, D4, PVT, SDD, SDE, SDL, SDS,SLP, SOF, SLV, SLL1, SLL2, EGI, ADD, FRS, SYZ, UP, DN, CLO	2-4	2-7
Data Entry/ DataTerminator Commands	0 thru 9, –, ., ADR, CLR, DB, DM, GH, MH, KH, HZ, SEC, MS, US, NS, PCT, RD, GV, MV, KV, DV, PCV, RV, SPS, TMS	2-4	2-13, 2-14
CW Frequency Commands	CF0, CF1, CF2, CF3, CF4, CF5, CF6, CF7, CF8, CF9, CM0, CM1, CM2, CM3, CM4, CM5, CM6, CM7, CM8, CM9, SQF, SQU, SQD, ACW	2-5	2-16
Analog and Step Sweep Commands	SF1, SF3, FUL, DF0, DF1, DF5, DF6, AFU, AF1, AF3, AD1, AD5, AD6, AUT, EXT, TRG, TRS, RSS, SWP, SSP, MAN, DU1, DU0, TSS, SP1, SP0	2-6	2-17
Frequency Marker Commands	ME1, ME0, MK0, IM1, VM1	2-7	2-22
Output Power Leveling Commands	L0, L1, L2, L3, L4, L5, L6, L7, L8, L9, AL0, AL1, AL2, AL3, AL4, AL5, AL6, AL7, AL8, AL9, RF1, RF0, LO1, LO0, IL1, DL1, PL1, ELF, ELR, LV0, LSP, AT0, AT1, ATT(xx), SL0, SL1, EGO	2-8	2-24
Modulation Commands	AM0, AM1, AM2, AM3, AM4, AM5, AM6, AM7, AM8, AMW(x), FM0, FM1, FM2, FM3, FM4, FM5, FM6, FM7, FM8, FM9, FMN, FMW, FML, FMU, FWV(x), PH0, PH1, PH2, PH3, PH4, PH5, PH6, PH7, PH8, PHN, PHW, PHV(x), P0, IP, XP, P3, P4, PC1, PC4, PMD(x), PTG(x), PTR, PTF, GP, DPT, SD0, SD1, SQP, SW0, SW1, SW2, SW3, SW4, SW5, SW6, SC0, SC1	2-9	2-28

GPIB Command Group Function	Command Codes	Para.	Page
Measure Function Commands	AMI, FMD, MOM, PM1, PM0	2-10	2-39
Output Commands	*IDN?, OI, OFL, OFH, OF0, OF1, OF2, OF3, OF4, OF5, OF6, OF7, OF8, OF9, OM0, OM1, OM2, OM3, OM4, OM5, OM6, OM7, OM8, OM9, OL0, OL1, OL2, OL3, OL4, OL5, OL6, OL7, OL8, OL9, OLO, ODF, OPD, OPS, OSD, OSS, OST, OAD1, OAD2, OAR, OAW, OAS, OAB, OAI, OAE, OFD, OFR, OFW, OFK, OFS, OFI, OFE, OPR, OPP, OPW, OW1, OW2, OW3, OW4, ODP, OD1, OD2, OD3, OD4, ODD, ODE, ODL, ODS, OMD, OPC, OPT, OP5, OP3, OMM, OPHD, OPHR, OPHW, OPHM, OPHS, OPHI, OPHE, OPM, OVN, OWT, OSE, OEM, OES, OSB,OSM, OSR	2-11	2-40
Stored Setup Commands	SAF, SAM, SM, SSN(M_{1-9}), RCF, RCM, RSN(M_{1-9})	2-12	2-45
Service Request and Status Byte Commands	ES1, ES0, FB1, FB0, LE1, LE0, MB0, MB1, MB2, PE1, PE0, SB1, SB0, SE1, SE0, SQ1, SQ0, UL1, UL0, LS1, LS0, EL1, EL0, II1, II0, CSB	2-13	2-47
Configuration Commands	BPN, BPP, EP0, EP1, FRS, PPO, PPC, RC0, RC1, RT0, RT1, RO0, RO1, TR0, TR1	2-14	2-52
Group Execute Trigger (GET) Commands	GTC, GTD, GTF, GTL, GTO, GTS, GTT, GTU, Y	2-15	2-54
Fast-Frequency-Switching Commands	ZL($X_{000-999}$), ZEL, ZS($X_{000-999}$)	2-16	2-55
Power-Offset-Table Commands	PT0, PT1, PTC, PTL	2-17	2-56
User Level Calibration Commands	LU0, LU1, LU2, LU3, LU4, LU5, LUS, LUR	2-18	2-59
Master-Slave Operation Commands	S0, S1	2-19	2-67

Table 2-1. 682XXB/683XXB GPIB Command Codes Listed by Function (3 of 3)

GPIB Command Group Function	Command Codes	Para.	Page
Self Test Command	TST	2-20	2-68
Miscellaneous Commands	ADD, CS0, CS1, DS0, DS1, RL, RST, SNR	2-21	2-70

2-3 DATA INPUT RESTRICTIONS

The 682XXB/683XXB signal generator does ***not*** accept parameter or data entries in an exponential or scientific notation format. The accepted data formats are as follows:

- A decimal or integer format for entering parameters and data.
- A binary-byte format for entering the status byte mask commands (paragraph 2-13), the RCF and RCM stored-setup commands (paragraph 2-12), the power-offset-table commands (paragraph 2-17), and the LUR user level calibration command (paragraph 2-18).

Programming Note: The signal generator only recognizes the following 65 characters:

- The 52 upper- and lower-case alphabetic characters. (The 682XXB/683XXB accepts both upper- and lower-case characters without distinguishing between the cases).
- The minus sign (–).
- The comma (,).
- The decimal point (.).
- The numerals between 0 and 9.

All characters other than the 65 listed above are ignored and can be interspersed between meaningful characters without ill effect. This use of other characters can improve readability. For example, the two command strings below are valid and interchangable.

```
"F12.754GHF27.792GHSF1SWPMK0L12DM"

"F1=2.754 GH, F2=7.792 GH, SF1, SWP, MK0, L1=2 DM"
```

2-4 PARAMETER AND DATA ENTRY COMMANDS

Table 2-2 lists the command mnemonic codes that open parameters for data entry. The table also provides the range of values permitted for each parameter and the data terminator mnemonic codes for each. Tables 2-3 and 2-4 (pages 2-13 and 2-14) list the data entry and data terminator command mnemonic codes.

Opening a Parameter

All of the commands listed in Table 2-2 open a parameter for data entry. Once opened, a parameter remains open until one of the following occurs:

- Another parameter is opened.
- A function other than video markers, intensity markers, or output power leveling is commanded.
- The CLO (close open parameter) command is received.

Data Entry

When a parameter is open for data entry, its value can be changed as follows:

- By sending a numeric value followed by the appropriate terminator code.
- By incrementing or decrementing its value using an associated step size.

NOTE

An appropriate data terminator *must* be used to terminate a numeric-parameter entry, and it *must* immediately follow the numeric value. If it does not, a parameter entry error will result.

The parameter and data entry commands do not affect the signal generator's output unless the parameter being changed is also the current output parameter. The commands, therefore, may be used to change the preset values of parameters without altering the 682XXB/683XXB output.

Example: Assume that the 682XXB/683XXB is executing an F3-F4 sweep from 3 GHz to 10 GHz. Changing the value of F1 to 3 GHz with the command string "**`F1 3 GH`**" does not affect the current output of the signal generator. However, changing the value of F4 with the command string "**`F4 16.01 GH`**" alters the output of the 682XXB/683XXB because it changes the end point of the F3-F4 sweep to 16.01 GHz.

Table 2-2. Parameter Entry Commands (1 of 5)

MNEMONIC CODE	PARAMETER	VALUES	TERMINATOR
F0	Opens the F0 parameter	Dependent on the frequency range of the instrument	GH MH KH HZ
F1	Opens the F1 parameter		
F2	Opens the F2 parameter		
F3	Opens the F3 parameter		
F4	Opens the F4 parameter		
F5	Opens the F5 parameter		
F6	Opens the F6 parameter		
F7	Opens the F7 parameter		
F8	Opens the F8 parameter		
F9	Opens the F9 parameter		
M0	Opens the M0 parameter	Dependent on the frequency range of the instrument	GH MH KH HZ
M1	Opens the M1 parameter		
M2	Opens the M2 parameter		
M3	Opens the M3 parameter		
M4	Opens the M4 parameter		
M5	Opens the M5 parameter		
M6	Opens the M6 parameter		
M7	Opens the M7 parameter		
M8	Opens the M8 parameter		
M9	Opens the M9 parameter		
XL0	Opens the L0 parameter	Dependent on the power level range of the instrument	DM
XL1	Opens the L1 parameter		
XL2	Opens the L2 parameter		
XL3	Opens the L3 parameter		
XL4	Opens the L4 parameter		
XL5	Opens the L5 parameter		
XL6	Opens the L6 parameter		
XL7	Opens the L7 parameter		
XL8	Opens the L8 parameter		
XL9	Opens the L9 parameter		
DLF	Opens the ΔF parameter	Dependent on the frequency range of the instrument	GH MH KH HZ
DFF	Opens the ΔF parameter		
DFM	Opens the ΔF parameter		
	Slave Unit Frequencies		
SLF0	Opens the F0 parameter	Dependent on the frequency range of the instrument	GH MH KH HZ
SLF1	Opens the F1 parameter		
SLF2	Opens the F2 parameter		
SLF3	Opens the F3 parameter		
SLF4	Opens the F4 parameter		
SLF5	Opens the F5 parameter		
SLF6	Opens the F6 parameter		
SLF7	Opens the F7 parameter		
SLF8	Opens the F8 parameter		
SLF9	Opens the F9 parameter		

Table 2-2. Parameter Entry Commands (2 of 5)

MNEMONIC CODE	PARAMETER	VALUES	TERMINATOR
	Slave Unit Frequencies		
SLM0	Opens the M0 parameter	Dependent on the frequency range of the instrument	GH MH KH HZ
SLM1	Opens the M1 parameter		
SLM2	Opens the M2 parameter		
SLM3	Opens the M3 parameter		
SLM4	Opens the M4 parameter		
SLM5	Opens the M5 parameter		
SLM6	Opens the M6 parameter		
SLM7	Opens the M7 parameter		
SLM8	Opens the M8 parameter		
SLM9	Opens the M9 parameter		
SLDF	Opens the ΔF parameter for the slave 68XXXB	Dependent on the frequency range of the instrument	GH MH KH HZ
SDT	Opens the step sweep dwell time parameter	1 ms to 99s	MS SEC
SNS	Opens the step sweep number of steps parameter	1 to 10,000	SPS
SWT	Opens the analog sweep and CW ramp time parameter	30 ms to 99s	MS SEC
LOS	Opens the level offset parameter	+100 dB to −100 dB	DB
PDT	Opens the power sweep dwell time parameter	1 ms to 99 sec	MS SEC
PNS	Opens the power sweep number of steps parameter	1 to 10,000	SPS
ADP1	Opens the internal AM % depth parameter	0% to 100%	PCT
ADP2	Opens the internal AM dB depth parameter	0 dB to 25 dB	DB
AMR	Opens the internal AM rate parameter	0.1 Hz to 1 MHz for sine wave; 0.1 Hz to 100 kHz for square, triangle, and ramp waveforms	MH KH HZ

Table 2-2. Parameter Entry Commands (3 of 5)

MNEMONIC CODE	PARAMETER	VALUES	TERMINATOR
AMS	Opens the external AM %/V sensitivity parameter	0 %/V to 100 %/V	PCV
ASD	Opens the external AM dB/V sensitivity parameter	0 dB/V to 25 dB/V	DV
FDV	Opens the internal FM deviation parameter	10 kHz to 20 MHz in Locked, Locked Low-Noise, and Unlocked Narrow FM; 100 kHz to 100 MHz in Unlocked Wide FM	MH KH
FMR	Opens the internal FM rate parameter	0.1 Hz to 1 MHz for sine wave; 0.1 Hz to 100 kHz for square, triangle, and ramp waveforms	MH KH HZ
FMS	Opens the external FM sensitivity parameter	±10 kHz/V to ±20 MHz/V in Locked, Locked Low-Noise, and Unlocked Narrow FM; ±100 kHz/V to ±100 MHz/V in Unlocked Wide FM	KV MV
PHD	Opens the internal ΦM deviation parameter	0.0025 to 5 radians in ΦM Narrow mode; 0.25 to 500 radians in ΦM Wide mode	RD
PHR	Opens the internal ΦM rate parameter	0.1 Hz to 1 MHz for sine wave; 0.1 Hz to 100 kHz for square, triangle, and ramp waveforms	MH KH HZ
PHS	Opens the external ΦM sensitivity parameter	±0.0025 radians/V to ±5 radians/V in ΦM Narrow mode; ±0.25 radians/V to ±500 radians/V in ΦM Wide mode	RV

Table 2-2. Parameter Entry Commands (4 of 5)

MNEMONIC CODE	PARAMETER	VALUES	TERMINATOR
PER	Opens the internal pulse period parameter	250 ns to 419 ms at 40 MHz pulse clock rate; 600 ns to 1.6s at 10 MHz pulse clock rate	SEC MS US NS
PR	Opens the internal pulse frequency parameter	2.385 Hz to 4 MHz at 40 MHz pulse clock rate; 0.597 Hz to 1.66 MHz at 10 MHz pulse clock rate	MH KH HZ
PW, W1 W2 W3 W4	Opens the internal pulse width 1 parameter Opens the internal pulse width 2 parameter Opens the internal pulse width 3 parameter Opens the internal pulse width 4 parameter	25 ns to 419 ms at 40 MHz pulse clock rate; 100 ns to 1.6s at 10 MHz pulse clock rate	SEC MS US NS
PDY, D1	Opens the internal pulse delay 1 parameter	0 to 419 ms at 40 MHz pulse clock rate; 0 to 1.6 s at 10 MHz pulse clock rate	SEC MS US NS
D2 D3 D4	Opens the internal pulse delay 2 parameter Opens the internal pulse delay 3 parameter Opens the internal pulse delay 4 parameter	100 ns to 419 ms at 40 MHz pulse clock rate; 300 ns to 1.6s at 10 MHz pulse clock rate	SEC MS US NS
SDD	Opens the internal pulse stepped delay mode step size parameter	0 to 419 ms at 40 MHz pulse clock rate; 0 to 1.6 s at 10 MHz pulse clock rate	SEC MS US NS
SDE	Opens the internal pulse stepped delay mode delay 1 stop parameter	0 to 419 ms at 40 MHz pulse clock rate; 0 to 1.6 s at 10 MHz pulse clock rate	SEC MS US NS
SDL	Opens the internal pulse stepped delay mode dwell-time-per-step parameter	100 µs to 10s	SEC MS US

Table 2-2. Parameter Entry Commands (5 of 5)

MNEMONIC CODE	PARAMETER	VALUES	TERMINATOR
SDS	Opens the internal pulse stepped delay mode delay 1 start parameter	0 to 419 ms at 40 MHz pulse clock rate; 0 to 1.6 s at 10 MHz pulse clock rate	SEC MS US NS
PVT	Opens the ALC power slope pivot point frequency parameter	Dependent on the frequency range of the instrument	GH MH KH HZ
SLP	Opens the ALC power slope value parameter	0 to 255	SPS
SOF	Opens the frequency offset parameter for the slave 68XXXB (in a 360B VNA configuration)	Dependent on the frequency range of the instrument	GH MH KH HZ
SLV, SLL1	Opens the main power level parameter (L1) for the slave 68XXXB	Dependent on the power level range of the instrument	DM
SLL2	Opens the alternate sweep power level parameter (L2) for the slave 68XXXB	Dependent on the power level range of the instrument	DM
EGI	Opens the Reference Level DAC setting parameter (in external power leveling mode)	0 to 255	SPS
ADD	Opens the GPIB address parameter.	1 to 30	ADR
FRS	Opens the frequency scaling reference multiplier parameter	0.1 to 14	TMS
SYZ	Opens the step-size parameter for updating	Dependent on the open parameter	N/A
UP	Increments the open parameter by the step size	N/A	N/A
DN	Decrements the open parameter by the step size	N/A	N/A
CLO	Closes the previously opened parameter	N/A	N/A

Table 2-3. Data Entry Commands

MNEMONIC CODE	DESCRIPTION
0, 1, 2, 3, 4, 5, 6, 7, 8, 9	Numerals for parameter value entries
–	Change sign of input
.	Decimal point
CLR	Clear data entry

Table 2-4. Data Terminator Codes

MNEMONIC CODE	DESCRIPTION
ADR	GPIB Address
DB	Decibels (dB)
DM	dBm
GH	GHz
MH	MHz
KH	kHz
HZ	Hertz (Hz)
SEC	Seconds
MS	Milliseconds (ms)
US	Microseconds (μs)
NS	Nanoseconds (ns)
PCT	Percent (%)
RD	Radians
GV	GHz per volt (GHz/V)
MV	MHz per volt (MHz/V)
KV	kHz per volt (kHz/V)
DV	Decibel per volt (dB/V)
PCV	Percent per volt (%/V)
RV	Radians per volt (rad/V)
SPS	Steps
TMS	Times

Using the SYZ Command

Each 682XXB/683XXB parameter has an associated step size that can be used to increment or decrement its value. Parameters that have common units share a common step size. For example, the frequency parameters (F0-F9, M0-M9, and ΔF) have a common step size as do the power level parameters (XL0-XL9, L0-L9, and Level Offset). Other parameters, such as analog sweep time, have individual step sizes.

To set the step size for a parameter, first send the command code to open the parameter, then send the SYZ command. Now set the step size by sending a numeric string with the proper terminator. When the terminator is received, the step size is accepted and the original parameter is again open for entry.

Figure 2-1 shows how the SYZ command can be used to increment a parameter. In this example, the F1 frequency parameter is set to 4 GHz, the step size is set to 10 MHz, and F1 frequency is incremented three times by the value of the step size.

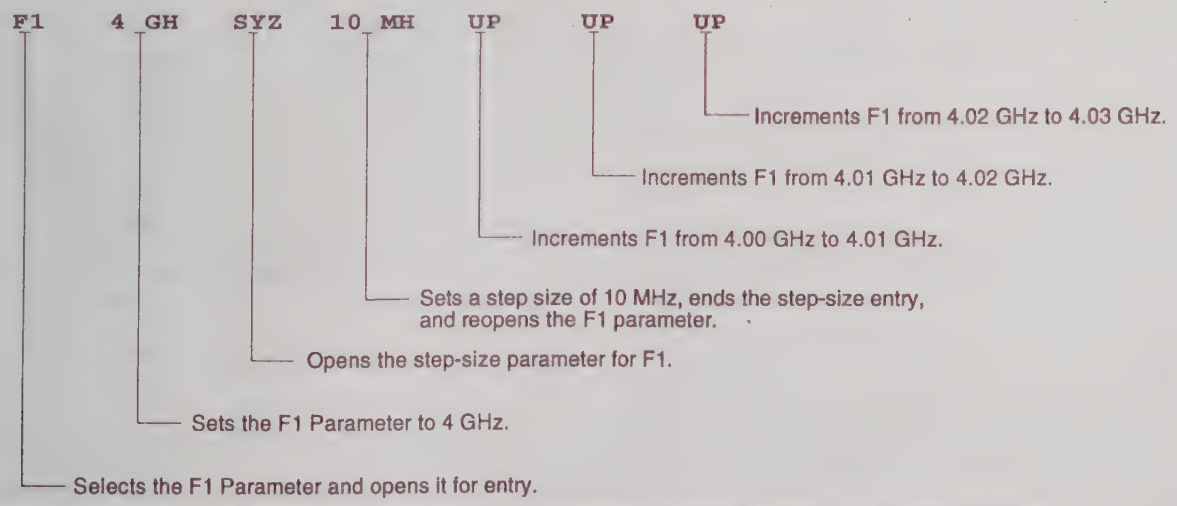

F1
4 GH
SYZ
10 MH
UP
UP
UP
Increments F1 from 4.02 GHz to 4.03 GHz.
Increments F1 from 4.01 GHz to 4.02 GHz.
Increments F1 from 4.00 GHz to 4.01 GHz.
Sets a step size of 10 MHz, ends the step-size entry, and reopens the F1 parameter.
Opens the step-size parameter for F1.
Sets the F1 Parameter to 4 GHz.
Selects the F1 Parameter and opens it for entry.

Figure 2-1. *Using the SYZ (Step Size) Command*

2-5 CW FREQUENCY COMMANDS

Table 2-5 lists the CW frequency command mnemonic codes. These commands call up each of the 20 preset (or previously set) CW frequencies. Each command causes its associated CW frequency to be output and opens that frequency's parameter for data entry.

The command, SQF, accesses the preset frequencies in sequential order—that is, F0 to F9 and M0 to M9.

Table 2-5. CW Frequency Commands

MNEMONIC CODE	FUNCTION	OPENS FOR ENTRY
CF0	Set CW mode at F0	F0 parameter
CF1	Set CW mode at F1	F1 parameter
CF2	Set CW mode at F2	F2 parameter
CF3	Set CW mode at F3	F3 parameter
CF4	Set CW mode at F4	F4 parameter
CF5	Set CW mode at F5	F5 parameter
CF6	Set CW mode at F6	F6 parameter
CF7	Set CW mode at F7	F7 parameter
CF8	Set CW mode at F8	F8 parameter
CF9	Set CW mode at F9	F9 parameter
CM0	Set CW mode at M0	M0 parameter
CM1	Set CW mode at M1	M1 parameter
CM2	Set CW mode at M2	M2 parameter
CM3	Set CW mode at M3	M3 parameter
CM4	Set CW mode at M4	M4 parameter
CM5	Set CW mode at M5	M5 parameter
CM6	Set CW mode at M6	M6 parameter
CM7	Set CW mode at M7	M7 parameter
CM8	Set CW mode at M8	M8 parameter
CM9	Set CW mode at M9	M9 parameter
SQF	Scan to the next higher preset CW frequency.	CW frequency parameter then selected
SQU	Scan up to the next higher preset CW frequency.	CW frequency parameter then selected
SQD	Scan down to the next lower preset CW frequency.	CW frequency parameter then selected
ACW	Activates the currently scanned frequency as CW.	CW frequency parameter then selected

Programming Note: Signal generator response to a SQF command depends on the state that the instrument is in at the time the command is received. For example, if the 682XXB/683XXB is in a CW mode of operation with the current output frequency open for entry, the SQF command (1) causes the output to change to the next sequential frequency and (2) opens that frequency's parameter for data entry. However, if the instrument is in any other mode of operation, the SQF command causes it to switch to the last CW frequency that was output and opens that parameter for data entry.

Figure 2-2 is an example of a CW frequency command string.

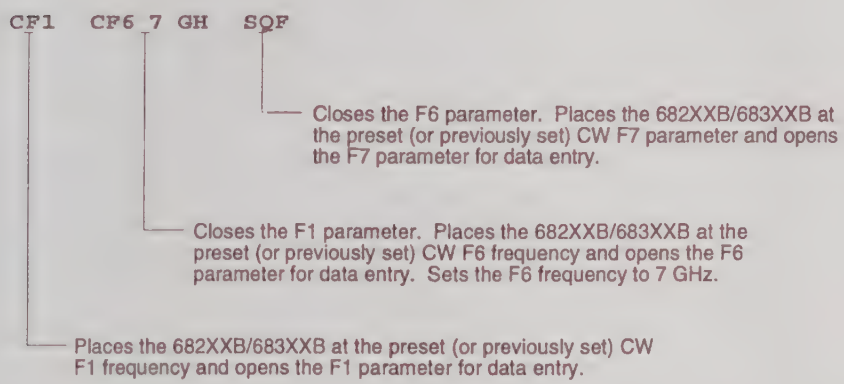

CF1 CF6 7 GH SQF
Closes the F6 parameter. Places the 682XXB/683XXB at the preset (or previously set) CW F7 parameter and opens the F7 parameter for data entry.
Closes the F1 parameter. Places the 682XXB/683XXB at the preset (or previously set) CW F6 frequency and opens the F6 parameter for data entry. Sets the F6 frequency to 7 GHz.
Places the 682XXB/683XXB at the preset (or previously set) CW F1 frequency and opens the F1 parameter for data entry.

Figure 2-2. *Example of a CW Frequency Command String*

2-6 ANALOG AND STEP SWEEP COMMANDS

Table 2-6 (page 2-19) lists the analog and step sweep command mnemonic codes. These commands are divided into five subclasses and are described in the following paragraphs.

Sweep Range Seven sweep ranges are available. The SF1 and SF3 commands select the sweep ranges of F1-F2 and F3-F4 respectively; the FUL command selects a full band sweep from the signal generator's low frequency limit to its high frequency limit.

The DF0, DF1, DF5, and DF6 commands each select a symmetrical frequency sweep around F0, F1, F5, and F6 respectively. The width of the sweep is determined by the ΔF frequency parameter.

Programming Examples:
Programming "`F1 2 GH F2 8 GH SF1`" sets F1 to 2 GHz, F2 to 8 GHz, and implements a F1-F2 frequency sweep.

Programming "`DLF 6 GH F5 7 GH DF5`" sets ΔF to 6 GHz, F5 to 7 GHz, and implements a F5-ΔF frequency sweep.

Programming Note:
If the commanded sweep range is invalid, a parameter error (paragraph 2-22) will be generated, and the output of the signal generator will not be altered.

A sweep range is invalid if (1) the analog sweep start frequency is greater than the stop frequency, or (2) the ΔF frequency parameter results in a sweep that is outside the range of the instrument.

Alternate Sweep

Six alternate sweep commands are available. If the 682XXB/683XXB is sweeping when the alternate sweep command is received, the signal generator's output will alternate between the commanded sweep and the sweep then being executed.

Programming Example:
Assume that the 682XXB/683XXB had been previously programmed and was then executing an F1-F2 sweep. Programming "`AF3`" would then activate the F3-F4 sweep and cause it to alternate with the F1-F2 sweep.

Programming Note:
An alternate sweep command will only be recognized when the 682XXB/683XXB has been programmed to sweep. It will be ignored at all other times.

Sweep Triggering

Two modes of sweep triggering are available over the bus—Automatic and Single. The AUT command selects automatic sweep triggering; the EXT command selects single sweep triggering.

When automatic sweep triggering is selected, the sweep continually sweeps from its start frequency (or power level) to its stop frequency (or power level) with optimal retrace time.

When single sweep triggering is selected, a single sweep starts when the TRG or TRS command is received. The RSS command resets the sweep to its start frequency (or power level), whenever the command is received while a single sweep is in progress.

Table 2-6. Analog and Step Sweep Commands

MNEMONIC CODE	FUNCTION	OPENS FOR ENTRY
	Sweep Range	
SF1	Selects the F1-F2 sweep mode	None
SF3	Selects the F3-F4 sweep mode	None
FUL	Selects the Full Range sweep mode	None
DF0	Selects the F0-ΔF sweep mode	None
DF1	Selects the F1-ΔF sweep mode	None
DF5	Selects the F5-ΔF sweep mode	None
DF6	Selects the F6-ΔF sweep mode	None
	Alternate Sweep	
AFU	Selects Full Range alternate sweep	None
AF1	Selects F1-F2 alternate sweep	None
AF3	Selects F3-F4 alternate sweep	None
AD1	Selects F1-ΔF alternate sweep	None
AD5	Selects F5-ΔF alternate sweep	None
AD6	Selects F6-ΔF alternate sweep	None
	Sweep Triggering	
AUT	Selects Auto Trigger	None
EXT	Selects Single Trigger	None
TRG	Triggers a Single Sweep	None
TRS	Triggers a Single Sweep	None
RSS	Resets a Sweep if in progress	None
	Analog/Step Sweep Select	
SWP	Selects Analog Sweep (683XXB only)	None
SSP	Selects Step Sweep	None
MAN	Selects Manual (Step) Sweep	None
DU1	Selects Dual Step Sweep mode	None
DU0	Deselects Dual Step Sweep mode	None
TSS	Steps to next point in DU1 mode	None
	Special Step Sweep (Steps Not Equally Spaced)	
SP1	Selects non-equally spaced step sweep	None
SP0	Deselects non-equally spaced step sweep	None

Analog/Step Sweep Select

Three commands are available—SWP selects an analog sweep, SSP selects a step sweep, and MAN selects a manual (step) sweep. The selected sweep mode applies to all sweep ranges. Figure 2-3 shows an example of a sweep command string.

NOTE

Series 683XXB signal generators can produce analog, step, and manual sweeps; series 682XXB signal generators can produce only step and manual sweeps.

Programming Notes:

Commanding either SWP or SSP does not, by itself, provide a swept-frequency output. It only determines whether the swept-frequency output will be an analog or step sweep. If, on the other hand, a frequency sweep is being output by the signal generator when one of these commands is received, that sweep will assume the commanded sweep mode.

The MAN command only provides for setting up the 682XXB/683XXB for a manual sweep. It must be accompanied by the RL command to return the instrument to local (front panel) control in order for the operator to perform the manual sweep.

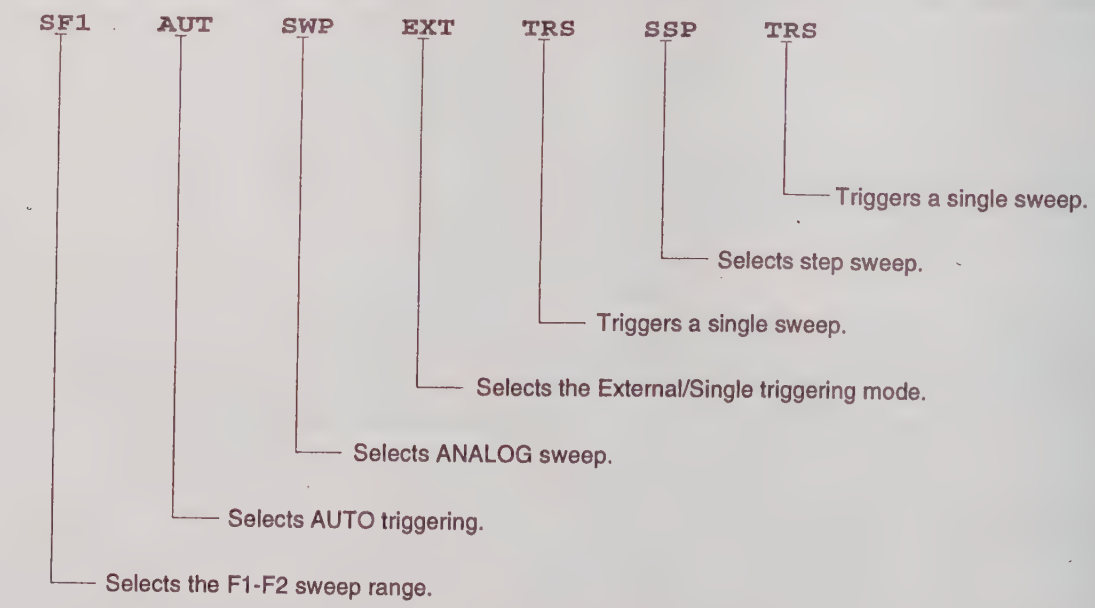


Figure 2-3. *Example of a Sweep Command String*

Dual Step Sweep Mode

The dual step sweep mode provides for generating synchronized, step sweep outputs from two 682XXB/683XXBs at a frequency offset. Figure 2-4 shows an example of dual step sweep programming.

```
 10 !     "DUAL"
 20 CLEAR
 30 DISP "ENTER # OF STEPS"
 40 INPUT S
 50 DISP "ENTER WAIT TIME [mS]
 60 INPUT W
 70 WAIT 100
 80 DISP "ENTER 'LO' START FREQ [GHz]"
 90 INPUT F1
100 DISP "ENTER 'LO' STOP FREQ [GHz]
110 INPUT F2
120 DISP "ENTER OFFSET [GHz]
130 INPUT F3
140 !
150 ! Initialize both 682XXB/683XXB's
160 !
170 OUTPUT 705 ;"CF1F1";F1;"GHF2";F2;
    "GHSNS";S;"SPSSSPEXTCLO"
180 OUTPUT 706 ;"CF1F1";F1+F3;"GHF2";
    F2+F3;"GHSNS";S;"SPSSSPEXTCLO"
190 WAIT 1000
200 !
210 ! Set both to dual mode and enable
    GET to end DWELL
220 !
230 SEND 7 ; CMD "%&" DATA "GTLDU1SF1"
    EOL
240 WAIT 100
250 ! Trigger the sweep and wait for
    retrace to finish
260 SEND 7 ; CMD "%&" DATA "TRS" EOL
270 WAIT 100
280 ! Listen address both 682XXB/683XXB's
290 SEND 7 ; CMD "%&"
300 FOR C+1 TO S+1
310 WAIT W
320 ! Trigger both to next point
330 TRIGGER 7
340 NEXT C
350 GOTO 260
```

Figure 2-4. *Dual Step Sweep Programming Example*

Special Step Sweep

This special step sweep provides for a step sweep that has non-equally spaced steps. It can be used in any of the available sweep ranges (F1-F2, F3-F4, Full, F0-ΔF, F1-ΔF, F5-ΔF, and F6-ΔF). The start frequency in this sweep must be equal to the first frequency programmed with the ZL($X_{000-999}$) command (Table 2-16). The intermediate steps can be programmed to be any frequency within the range of the programmed sweep.

Programming Note:
The SP1 command can be used with the dual step sweep mode.

Figure 2-5 shows an example of special step sweep programming.

For this example, assume a frequency sweep of 3 GHz to 10 GHz, with steps at 3, 6, 8, 9, and 10 GHz.

Sample Coding in BASIC

```
10 OUTPUT 705; "ZL000 3GH 6GH 8GH 9GH 10GH ZEL"
20 OUTPUT 705; "F1 3GH F2 10GH SNS 4SPS"
30 OUTPUT 705; "SP1 SSP SF1"
```

Explanation of Code

Line 10 sets up the step frequencies.
Line 20 sets start and stop frequencies and number of steps (frequency points – 1).
Line 30 set the signal generator to SP1, Step Sweep, and F1-F2 sweep range.

Figure 2-5. *Special Step Sweep Programming Example*

2-7 FREQUENCY MARKER COMMANDS

Table 2-7 lists the frequency marker command mnemonic codes. These commands provide for (1) selecting a CW frequency as a potential marker, (2) selecting a potential marker as an active marker, and (3) individually turning markers on and off.

The ME1 command will enable a marker at the current frequency that is open for update; the ME0 command will disable the same marker. If a frequency parameter is not open, no action will be taken. The IM1 and VM1 commands will turn on their respective intensity and video markers. The MK0 command will turn all markers off.

NOTE

Series 683XXB signal generators can produce video and intensity markers; series 682XXB signal generators can produce *only* video markers.

Figure 2-6 shows an example of a frequency marker command string.

Table 2-7. Frequency Marker Commands

MNEMONIC CODE	FUNCTION	OPENS FOR ENTRY
ME1	Enables a marker at the active frequency (F0-F9 or M0-M9)	None
ME0	Disables the marker at the active frequency	None
MK0	Turns off markers. Enabled markers remain enabled, but are not active	None
IM1	Turns on the intensity marker mode (683XXB only)	None
VM1	Turns on the video marker mode	None

Programming Note: Only one marker mode can be active. Consequently, if the intensity marker mode is active and the video marker mode is programmed, the displayed markers will change to video markers. Either mode can be turned off with the MK0 command.

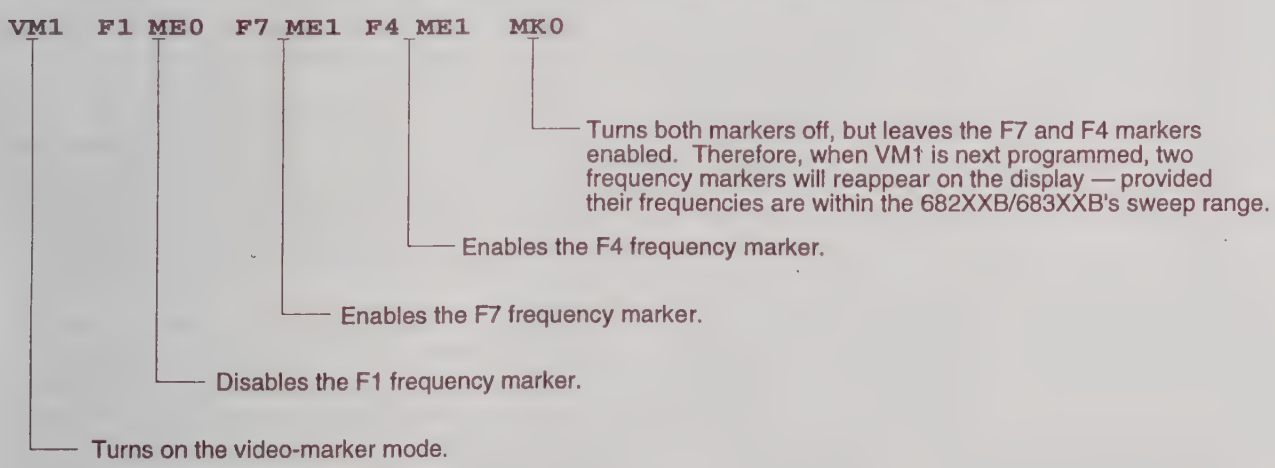

VM1 F1 ME0 F7 ME1 F4 ME1 MK0
Turns both markers off, but leaves the F7 and F4 markers enabled. Therefore, when VM1 is next programmed, two frequency markers will reappear on the display — provided their frequencies are within the 682XXB/683XXB's sweep range.
Enables the F4 frequency marker.
Enables the F7 frequency marker.
Disables the F1 frequency marker.
Turns on the video-marker mode.

Figure 2-6. *Example of a Frequency Marker Command String*

2-8 OUTPUT POWER LEVELING COMMANDS

Table 2-8 lists the output power leveling command mnemonic codes. These commands provide for (1) selecting an RF output power level, (2) leveling the output power and (3) turning the output power leveling off. In addition, commands are provided for the level offset, ALC power slope, and step attenuator decoupling functions.

Figure 2-7 (page 2-27) shows an example of an output power level command string.

RF Output Power Level Selection

The commands, L0 thru L9, call up each of the preset (or previously set) output power levels. Each command causes its associated RF power level to be output and opens that power level's parameter for data entry. Each command will also deselect any other previously programmed power level and will turn off a power level sweep, if active.

Alternate Sweep RF Output Power Level Selection

In the alternate sweep mode, the commands, AL0 thru AL9, call up each of the preset (or previously set) L0 to L9 output power levels. Each command causes its associated RF power level to be output during the alternate sweep. Each command will also deselect any other previously programmed alternate sweep power level. The commands do ***not*** open the L1 to L9 power level parameters for data entry. Use the parameter entry commands, XL0 thru XL9 or L0 thru L9, to enter new power level values.

Output Power Leveling

There are three output power leveling modes of operation—internal, external (detector or power meter), and fixed gain (leveling off). The IL1 command selects the internal leveling mode. In this mode, a signal from an internal level detector is used to level the output power. This is the default mode.

The DL1 command selects the external (detector) leveling mode; the PL1 command selects the external (power meter) leveling mode. In this mode, the output power is leveled using a signal from an external detector (power meter) connected to the EXTERNAL ALC IN connector. In the external power leveling mode, the parameter entry command EGI provides for entering a setting for the Reference Level DAC to control the ALC gain. The LV0 command selects the fixed gain (leveling off) mode. Each command will also deselect any other previously programmed output power leveling mode.

Programming Example:
Programming "**PL1 EGI 140 SPS**" selects external leveling of the output power using a signal from an external power meter and sets the Reference Level DAC to 140.

Table 2-8. Power Leveling Commands (1 of 2)

MNEMONIC CODE	FUNCTION	OPENS FOR ENTRY
L0	Set RF output power level to L0	L0
L1	Set RF output power level to L1	L1
L2	Set RF output power level to L2	L2
L3	Set RF output power level to L3	L3
L4	Set RF output power level to L4	L4
L5	Set RF output power level to L5	L5
L6	Set RF output power level to L6	L6
L7	Set RF output power level to L7	L7
L8	Set RF output power level to L8	L8
L9	Set RF output power level to L9	L9
AL0	Set alternate sweep RF output level to L0	None
AL1	Set alternate sweep RF output level to L1	None
AL2	Set alternate sweep RF output level to L2	None
AL3	Set alternate sweep RF output level to L3	None
AL4	Set alternate sweep RF output level to L4	None
AL5	Set alternate sweep RF output level to L5	None
AL6	Set alternate sweep RF output level to L6	None
AL7	Set alternate sweep RF output level to L7	None
AL8	Set alternate sweep RF output level to L8	None
AL9	Set alternate sweep RF output level to L9	None
RF1	Turns on the RF output. (This is the default mode.)	None
RF0	Turns off the RF output.	None
LO1	Turns on the Level Offset function. The value of the Level Offset parameter is added to the level measured by the internal leveling loop. The resultant power level value is displayed.	None
LO0	Turns off the Level Offset function.	None
IL1	Selects internal leveling of the output power. (This is the default mode.) Deselects the DL1 or PL1 leveling modes, if previously programmed.	None

Table 2-8. Power Leveling Commands (2 of 2)

MNEMONIC CODE	FUNCTION	OPENS FOR ENTRY
DL1	Selects external leveling of the output power, using a signal from an external detector connected to the EXTERNAL ALC IN connector. Deselects the IL1 or PL1 leveling modes, if previously programmed.	None
PL1	Selects external leveling of the output power using a signal from an external power meter connected to the EXTERNAL ALC IN connector. Deselects the IL1 and DL1leveling modes, if previously programmed.	None
ELF	Selects front panel external leveling input.	None
ELR	Selects rear panel external leveling input.	None
LV0	Turns off leveling of the output power.	None
LSP	Selects the Power Sweep mode. The power level will sweep as determined by the preset (or previously set) dwell-time and number-of-steps parameters.	None
AT1	Selects ALC step attenuator decoupling.	None
AT0	Deselects ALC step attenuator decoupling.	None
ATT(xx)	Sets step attenuator value to xx (×10 dB) in the ALC step attenuator decouple mode. xx is an unsigned integer between 00 (0 dB attenuation) and 11 (110 dB attenuation).	None
SL1	Turns on the ALC power slope function.	None
SL0	Turns off the ALC power slope function.	None
EGO	Outputs the value of the Reference Level DAC setting in external power leveling mode	None

ALC Power Slope

The ALC power slope function provides for linearly increasing or decreasing output power as the frequency increases to compensate for system, cable, and waveguide variations due to changes in frequency. The SL1 command turns on the ALC power slope function. The power slope value and the pivot point frequency are changed using the SLP and PVT parameter entry commands. The SL0 command turns off the ALC power slope function.

Programming Example:
Programming "`SL1 SLP 128 SPS PVT 2.0 GH`" turns on the ALC power slope function and sets the power slope value to 128 and the pivot point frequency to 2 GHz.

Attenuator Decoupling

The attenuator decoupling function provides for decoupling of the step attenuator (if equipped) from the ALC system. The AT1 command decouples the step attenuator, the ATT(xx) command provides for setting the attenuation in 10 dB increments, and the AT0 command deselects the attenuator decoupling function.

Programming Example:
Programming "`AT1 ATT08`" decouples the step attenuator from the ALC system and sets the step attenuator value to 80 dB.

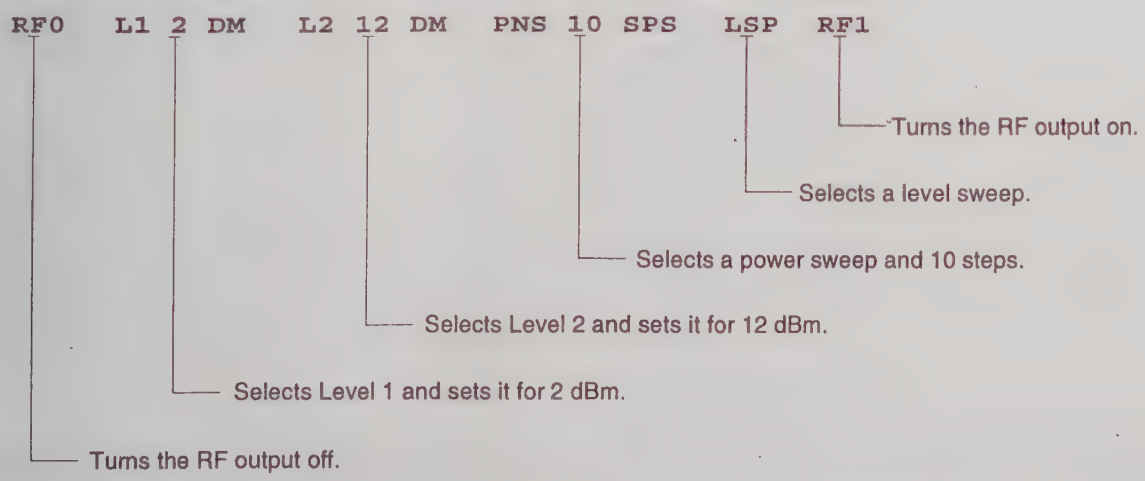

RF0 L1 2 DM L2 12 DM PNS 10 SPS LSP RF1
Turns the RF output on.
Selects a level sweep.
Selects a power sweep and 10 steps.
Selects Level 2 and sets it for 12 dBm.
Selects Level 1 and sets it for 2 dBm.
Turns the RF output off.

Figure 2-7. *Example of an Output Power Level Command String*

2-9 MODULATION COMMANDS

Table 2-9 (page 2-35) lists the modulation command mnemonic codes. These commands provide for AM, FM, ΦM, and pulse modulation of the signal generator's output signal using modulating signals from either the internal AM, FM, ΦM, and pulse generators or an external source.

Amplitude Modulation

Two AM modes are available—Linear and Log. In Linear AM mode, sensitivity is variable from 0 %/V to 100 %/V and the amplitude of the RF output changes linearly as the AM input changes. In Log mode, sensitivity is variable from 0 dB/V to 25 dB/V and the amplitude of the RF output changes exponentially as the AM input changes.

Internal AM Function

The AM7 command turns on the internal AM function in Linear mode. The AM8 command turns on the internal AM function in Log mode. In Linear mode, the AM depth value is changed using the ADP1 parameter entry command. In Log mode, the AM depth value is changed using the ADP2 parameter entry command. The modulating waveform is selected using the AMW(x) command and the AM rate is set with the AMR command. The AM0 command turns off the AM function.

Programming Example:

Programming "**AM8 ADP2 20 DB AMW7 AMR 10 KH**" turns on the internal AM function in Log mode, sets the AM depth to 20 dB, selects a triangle wave as the modulating waveform, and sets the AM rate to 10 kHz.

External AM Function

The AM1 command turns on the external AM function in Linear mode. The AM2 command turns on the external AM function in Log mode. In Linear mode, the external AM sensitivity value is changed using the AMS parameter entry command. In Log mode, the external AM sensitivity value is changed using the ASD parameter entry command. The AM0 command turns off the AM function.

Programming Example:

Programming "**AM1 AM3 AM5 AMS 90 PCV**" turns on the external AM function in Linear mode, selects the front panel external AM input, selects an input impedance of 50Ω, and sets the external AM sensitivity to 90 %/V.

Frequency Modulation

Four FM modes are available—Locked, Locked Low-Noise, Unlocked Narrow, and Unlocked Wide.

In the Locked and Locked Low-Noise FM modes, frequency modulation of the output signal is accomplished by summing the modulating signal into the FM control path of the YIG phase-lock loop. In Locked FM mode, the maximum FM deviation is the lesser of ±10 MHz or rate × 300 for 1 kHz to 8 MHz rates; in Locked Low-Noise FM mode, the maximum FM deviation is the lesser of ±10 MHz or rate × 3 for 50 kHz to 8 MHz rates.

In the Unlocked FM modes, the YIG phase-lock loop is disabled to allow for peak FM deviations of up to 100 MHz. In the Unlocked Narrow FM mode, frequency modulation is obtained by applying the modulating signal to the fine tuning coil of the YIG-tuned oscillator. Unlocked Narrow FM mode allows maximum deviations of ±10 MHz for DC to 8 MHz rates.

In the Unlocked Wide FM mode, frequency modulation is accomplished by applying the modulating signal to the main tuning coil of the YIG-tuned oscillator. Unlocked Wide FM mode allows maximum deviations of ±100 MHz for DC to 100 Hz rates.

Internal FM Function

The FM7 command turns on the internal FM function in Unlocked Narrow mode, the FM8 command turns it on in Unlocked Wide mode, the FM9 command turns it on in Locked mode, and the FMN command turns it on in Locked Low-Noise mode. The FM deviation value is changed using the FDV parameter entry command. The modulating waveform is selected using the FWV(x) command and the internal FM rate is set using the FMR parameter entry command. The FM0 command turns off the FM function.

Programming Example:

Programming "`FM9 FDV 20 MH FWV1 FMR 100 KH`" turns on the internal FM function in Locked mode, sets the FM deviation to 20 MHz, selects a sine wave as the modulating waveform, and sets the FM rate to 100 kHz.

External FM Function

The FM1 (or FMU) command turns on the external FM function in Unlocked Narrow mode, the FMW command turns it on in Unlocked Wide mode, the FML command turns it on in Locked mode, and the FM2 command turns it on in Locked Low-Noise mode. The external FM sensitivity value is changed using the FMS parameter entry command. The FM0 command turns off the FM function.

Programming Example:

Programming "`FMW FM4 FM6 FMS 50 MV`" turns on the external FM function in Unlocked Wide mode, selects the rear panel FM input, selects an input impedance of 600Ω, and sets the external FM sensitivity to 50 MHz/V.

Phase Modulation

Two ΦM modes are available—Narrow and Wide. In Narrow ΦM mode, the maximum ΦM deviation is the lesser of ±3 radians or ±5 MHz/rate for DC to 8 MHz rates. In Wide ΦM mode, the maximum ΦM deviation is the lesser of ±400 radians or ±10 MHz/rate for DC to 1 MHz rates.

Internal ΦM Function

The PH7 command turns on the internal ΦM function in Narrow mode and the PH8 command turns it on in Wide mode. The PHD parameter entry command is used to change the ΦM deviation value. The modulating waveform is selected with the PHV(x) command and the ΦM rate is set using the PHR parameter entry command. The PH0 command turns off the ΦM function.

NOTE

If the ΦM function (Option 6) is not installed in the signal generator, the ΦM function commands produce syntax errors.

Programming Example:

Programming "`PH7 PHD 3 RD PHV1 PHR 200 KH`" turns on the internal ΦM function in Narrow mode, sets the ΦM deviation to 3 radians, selects a sine wave as the modulating waveform, and sets the ΦM rate to 200 kHz.

External ΦM Function

The PH1 (or PHN) command turns on the external ΦM function in Narrow mode and the PH2 (or PHW) command turns it on Wide mode. The external ΦM sensitivity value is changed using the PHS parameter entry command. The PH3 and PH4 commands select front panel or rear panel external ΦM input.

Programming Example
Programming "**PH2 PH4 PH5 PHS 50 RV**" turns on the external ΦM function in Wide mode, selects the rear panel ΦM input, selects an input impedance of 50Ω, and sets the external ΦM sensitivity to 50 radians/V.

Pulse Modulation

Two pulse modulation modes are available—Internal and External. In Internal mode, pulse modulation of the output signal is accomplished by using a modulating signal from the internal pulse generator. In External mode, pulse modulation of the output signal is achieved using a modulating signal from an external source.

The internal pulse generator has four pulse modes–single, doublet (double pulse), triplet (triple pulse), and quadruplet (quadruple pulse). Individual pulse widths and delays can be set for each of the pulses in a mode. The pulse generator has two clock rates—40 MHz and 10 MHz. The 40 MHz clock rate produces higher resolution pulses (25 ns) and allows higher PRFs; the 10 MHz clock rate produces lower resolution pulses (100 ns) and lower PRFs.

The internal pulse generator can be internally triggered, externally triggered, internally and externally triggered with delay, and gated. There is also a composite trigger mode in which an external pulse is summed with the internal pulse to pulse modulate the output signal. (Refer to Chapter 3 of the 682XXB/683XXB Operation Manual for a description of each trigger mode.)

Internal Pulse Modulation Function
The IP command turns on the internal pulse modulation function. The internal pulse mode is selected using the PMD(x) command and the internal pulse trigger is selected using the PTG(x) command. The pulse period can be set using the PER parameter entry command; the pulse frequency can be set using the PR parameter entry command. Individual pulse widths can be set using the W1 (or PW), W2, W3, and W4 parameter entry commands. Individual pulse delays can be set using the D1 (or PDY), D2, D3, and D4 parameter entry commands. The P0 (or SW0) command turns off the pulse modulation function.

NOTE
At a 40 MHz pulse clock rate, the pulse period must be 125 ns longer than the pulse widths + delays; at a 10 MHz pulse clock rate, the pulse period must be 500 ns longer than the pulse widths + delays.

Square wave pulse modulation of the output signal by one of four internal modulating signals is available using the following commands:

- SW1 turns on square wave pulse modulation at 400 Hz.
- SW2 (or SQP) turns on square wave pulse modulation at 1 kHz.
- SW3 turns on square wave pulse modulation at 7.8125 kHz.
- SW4 turns on square wave pulse modulation at 27.8 kHz.

NOTE
Use the EP0 and EP1 commands to select the polarity of the signal (TTL-low or TTL-high) that turns the RF on during pulse modulation.

Programming Example:
Programming "`IP PC4 PMD2 PTG1 PER 1 MS W1 2.5 US D2 10 US W2 2 US`" turns on the internal pulse modulation function; selects the 40 MHz pulse clock rate, doublet pulse mode, and free run trigger mode; and sets the pulse period to 1 ms, pulse width1 to 2.5 µs, delay2 to 10 µs, and pulse width2 to 2 µs.

Stepped Delay Mode
The stepped delay mode automatically increments or decrements the pulse delay 1 value according to step delay parameters. Stepped delay mode is *only* available when the triggering commands PTG3 (delayed) or PTG5 (triggered with delay) are specified. The SD1 command turns on the stepped delay mode. The pulse delay 1 start time can be set using the SDS parameter entry command; the delay 1 stop time can be set using the SDE parameter entry command. Use the SDD parameter entry command to set the step size and the SDL parameter entry command to set the dwell-time-per-step. The SD0 command turns off the stepped delay mode.

Programming Notes:
Use the PTR and PTF commands in conjunction with the pulse trigger commands PTG2 (gated), PTG4 (triggered), and PTG5 (triggered with delay) to specify whether the pulse generator is triggered by the rising or falling edge of the external trigger pulse. Use the P3 (or SW5) and P4 (or SW6) commands to select front panel or rear panel external trigger pulse input.

External Pulse Modulation Function

The XP command turns on the external pulse modulation function. The P3 (or SW5) and P4 (or SW6) commands select front panel or rear panel external pulse input. The PO (or SW0) command turns off the pulse modulation function.

Table 2-9. Modulation Commands (1 of 6)

MNEMONIC CODE	FUNCTION
AM0	Turns off the internal or external AM function. (This is the default mode.)
AM1	Turns on the external AM function in Linear mode. Disables the internal AM function or the external AM function in Log mode, had either of these modes been previously programmed.
AM2	Turns on the external AM function in Log mode. Disables the internal AM function or the external AM function in Linear mode, had either of these modes been previously programmed.
AM3	Selects front panel external AM input.
AM4	Selects rear panel external AM input.
AM5	Selects external AM input impedance of 50Ω.
AM6	Selects external AM input impedance of 600Ω.
AM7	Turns on the internal AM function in Linear mode. Disables the external AM function or the internal AM function in Log mode, had either of these modes been previously programmed.
AM8	Turns on the internal AM function in Log mode. Disables the external AM function or the internal AM function in Linear mode, had either of these modes been previously programmed.
AMW(x)	Selects the internal AM waveform, where x = 1-sine wave, 2-square wave, 3-positive ramp, 4-negative ramp, 5-Gaussian noise, 6-uniform noise, 7-triangle wave.
FM0	Turns off the internal or external FM function. (This is the default mode.)

Table 2-9. Modulation Commands (2 of 6)

MNEMONIC CODE	FUNCTION
FM1	Turns on the external FM function in Unlocked Narrow mode. (The signal generator output is not phase-locked.) Disables the internal FM function or the external FM function in Unlocked Wide, Locked, or Locked Low-Noise mode, had any of these modes been previously programmed.
FM2	Turns on the external FM function in Locked Low-Noise mode. (The signal generator output is phase-locked.) Disables the internal FM function or the external FM function in Unlocked Narrow, Unlocked Wide, or Locked mode, had any of these modes been previously programmed.
FM3	Selects front panel external FM input.
FM4	Selects rear panel external FM input.
FM5	Selects external FM input impedance of 50Ω.
FM6	Selects external FM input impedance of 600Ω.
FM7	Turns on the internal FM function in Unlocked Narrow mode. (The signal generator output is not phase-locked.) Disables the external FM function or the internal FM function in Unlocked Wide, Locked, or Locked Low-Noise mode, had any of these modes been previously programmed.
FM8	Turns on the internal FM function in Unlocked Wide mode. (The signal generator is not phase-locked.) Disables the external FM function or the internal FM function in Unlocked Narrow, Locked, or Locked Low-Noise mode, had any of these modes been previously programmed.
FM9	Turns on the internal FM function in Locked mode. (The signal generator output is phase-locked.) Disables the external FM function or the internal FM function in Unlocked Narrow, Unlocked Wide, or Locked Low-Noise mode, had any of these modes been previously programmed.
FMN	Turns on the internal FM function in Locked Low-Noise mode. (The signal generator is phase-locked.) Disables the external FM function or the internal FM function in Unlocked Narrow, Unlocked Wide, or Locked mode, had any of these modes been previously programmed.
FMW	Turns on the external FM function in Unlocked Wide mode. (The signal generator output is not phase-locked.) Disables the internal FM function or the external FM function in Unlocked Narrow, Locked, or Locked Low-Noise mode, had any of these modes been previously programmed.

Table 2-9. Modulation Commands (3 of 6)

MNEMONIC CODE	FUNCTION
FML	Turns on the external FM function in Locked mode. (The signal generator output is phase-locked.) Disables the internal FM function or the external FM function in Unlocked Narrow, Unlocked Wide, or Locked Low-Noise mode, had any of these modes been previously programmed.
FMU	Same as FM1. Turns on the external FM function in Unlocked Narrow mode. (The signal generator output is not phase-locked.) Disables the internal FM function or the external FM function in Unlocked Wide, Locked, or Locked Low-Noise mode, had any of these modes been previously programmed.
FWV(x)	Selects the internal FM waveform, where x = 1-sine wave, 2-square wave, 3-positive ramp, 4-negative ramp, 5-Gaussian noise, 6-uniform noise, 7-triangle wave
PH0	Turns off the internal or external ΦM function. (This is the default mode.) If the ΦM function (Option 6) is not installed, this command produces a syntax error.
PH1	Turns on the external ΦM function in Narrow mode. Disables the internal ΦM function or the external ΦM function in Wide mode, had either of these modes been previously programmed. If the ΦM function (Option 6) is not installed, this command produces a syntax error.
PH2	Turns on the external ΦM function in Wide mode. Disables the internal ΦM function or the external ΦM function in Narrow mode, had either of these modes been previously programmed. If the ΦM function (Option 6) is not installed, this command produces a syntax error.
PH3	Selects front panel external ΦM input. If the ΦM function (Option 6) is not installed, this command produces a syntax error.
PH4	Selects rear panel external ΦM input. If the ΦM function (Option 6) is not installed, this command produces a syntax error.
PH5	Selects external ΦM input impedance of 50Ω. If the ΦM function (Option 6) is not installed, this command produces a syntax error.

Table 2-9. Modulation Commands (4 of 6)

MNEMONIC CODE	FUNCTION
PH6	Selects external ΦM input impedance of 600Ω. If the ΦM function (Option 6) is not installed, this command produces a syntax error.
PH7	Turns on the internal ΦM function in Narrow mode. Disables the external ΦM function or the internal ΦM function in Wide mode, had either of these modes been previously programmed. If the ΦM function (Option 6) is not installed, this command produces a syntax error.
PH8	Turns on the internal ΦM function in Wide mode. Disables the external ΦM function or the internal ΦM function in Narrow mode, had either of these modes been previously programmed. If the ΦM function (Option 6) is not installed, this command produces a syntax error.
PHN	Same as PH1. Turns on the external ΦM function in Narrow mode. Disables the internal ΦM function or the external ΦM function in Wide mode, had either of these modes been previously programmed. If the ΦM function (Option 6) is not installed, this command produces a syntax error.
PHW	Same as PH2. Turns on the external ΦM function in Wide mode. Disables the internal ΦM function or the external ΦM function in Narrow mode, had either of these modes been previously programmed. If the ΦM function (Option 6) is not installed, this command produces a syntax error.
PHV(x)	Selects the internal ΦM waveform, where x = 1-sine wave, 2-square wave, 3-positive ramp, 4-negative ramp, 5-Gaussian noise, 6-uniform noise, 7-triangle wave If the ΦM function (Option 6) is not installed, this command produces a syntax error.
P0	Turns off the internal or external pulse modulation function. (This is the default mode.)
IP	Turns on the internal pulse modulation function. Disables the external pulse modulation function, if previously programmed.
XP	Turns on the external pulse modulation function. Disables the internal pulse modulation function, if previously programmed.

Table 2-9. Modulation Commands (5 of 6)

MNEMONIC CODE	FUNCTION
P3	Selects front panel external pulse input to pulse modulate the RF output signal or to trigger or gate the internal pulse generator.
P4	Selects rear panel external pulse input to pulse modulate the RF output signal or to trigger or gate the internal pulse generator.
PC1	Selects the 10 MHz internal pulse generator clock rate.
PC4	Selects the 40 MHz internal pulse generator clock rate.
PMD(x)	Selects the internal pulse mode, where x = 1-single, 2-doublet, 3- triplet, 4-quadruplet.
PTG(x)	Selects the internal pulse trigger, where x = 1-free run, 2-gated, 3-delayed, 4-triggered, 5-triggered with delay, 6-composite.
PTR	Selects internal pulse triggering on the rising edge of an external input. Active only when pulse trigger is gated, triggered, or triggered with delay.
PTF	Selects internal pulse triggering on the falling edge of an external input. Active only when pulse trigger is gated, triggered, or triggered with delay.
GP	Sets the internal pulse mode to single, the internal pulse trigger to gated, and turns on the internal pulse modulation function. Disables the external pulse modulation function, if previously programmed.
DPT	Sets the internal pulse mode to single, the internal pulse trigger to triggered with delay, and turns on the internal pulse modulation function. Disables the external pulse modulation function, if previously programmed.
SD0	Turns off the internal pulse stepped delay mode.
SD1	Turns on the internal pulse stepped delay mode, if internal pulse modulation is on and the pulse trigger is "delayed" or "triigger with delay."
SQP	Turns on internal 1 kHz square wave pulse modulation. Sets the internal pulse width1 to 500 µs, PRF to 1 kHz, pulse mode to single, pulse trigger to free run, and turns on the internal pulse modulation function. Disables the external pulse modulation function, if previously programmed.

Table 2-9. Modulation Commands (6 of 6)

MNEMONIC CODE	FUNCTION
SW0	Same as P0. Turns off the internal or external pulse modulation function.
SW1	Turns on internal 400 Hz square wave pulse modulation. Sets the internal pulse width1 to 1.25 µs, PRF to 400 Hz, pulse mode to single, trigger to free run, pulse clock rate to 40 MHz, and turns on the internal pulse modulation function. Disables the external pulse modulation function, if previously programmed.
SW2	Same as SQP. Turns on internal 1 kHz square wave pulse modulation. Sets the internal pulse width1 to 500 µs, PRF to 1 kHz, pulse mode to single, pulse trigger to free run, and turns on the internal pulse modulation function. Disables the external pulse modulation function, if previously programmed.
SW3	Turns on internal 7.8125 kHz square wave pulse modulation. Sets the internal pulse width1 to 64 µs, PRF to 7.8125 kHz, pulse mode to single, pulse trigger to free run, and turns on the internal pulse modulation function. Disables the external pulse modulation function, if previously programmed.
SW4	Turns on internal 27.8 kHz square wave pulse modulation. Sets the internal pulse width1 to 18 µs, PRF to 27.8 kHz, pulse mode to single, pulse trigger to free run, pulse clock rate to 40 MHz, and turns on the internal pulse modulation function. Disables the external pulse modulation function, if previously programmed.
SW5	Same as P3. Selects front panel external pulse input to pulse modulate the RF output signal or to trigger or gate the internal pulse generator.
SW6	Same as P4. Selects rear panel external pulse input to pulse modulate the RF output signal or to trigger or gate the internal pulse generator.
SC0	Turns SCAN modulation function off. If the SCAN Modulator (Option 20) was not installed, this command produces a syntax error.
SC1	Turns SCAN modulation function on. If the SCAN Modulator (Option 20) was not installed, this command produces a syntax error.

2-10 MEASURE FUNCTION COMMANDS

Table 2-10 lists the measure function commands. These commands provide for measuring the following:

- The actual modulation depth of the RF output signal, as caused by an external AM signal connected to either the front panel or rear panel AM IN connector.
- The actual frequency deviation of the RF output signal, as caused by an external FM signal connected to either the front panel or rear panel FM IN connector.
- The actual RF power of an external source, via a 560-7, 5400-71, or 6400-71 Series Detector connected to the rear panel POWER METER connector. (To make RF power measurements, Option 8 must be installed.)

Table 2-10. Measure Function Commands

MNEMONIC CODE	FUNCTION
AMI	Turns on the AM Measurement mode. In this mode, the signal generator measures the voltage of the external modulating signal and calculates the modulation depth of the RF output signal. The measurement results will be sent to the controller upon receipt of the OMM command (Table 2-11). When the AMI command is received, measurements will continue to be taken until the mode is exited by receipt of the MOM command.
FMD	Turns on the FM Measurement mode. In this mode, the signal generator measures the voltage of the external modulating signal and calculates the peak frequency deviation of the RF output signal. The measurement results will be sent to the controller upon receipt of the OMM command (Table 2-11). When the FMD command is received, measurements will continue to be taken until the mode is exited by receipt of the MOM command.
MOM	Turns off the AM and FM measurement modes.
PM1	Turns on the Power Meter Measurement mode (Option 8), whereby RF power can be measured at an external source by a 560-7, 5400-71, or 4600-71 Series Detector connected to the rear panel POWER METER connector. The measurement results will be sent to the controller upon receipt of the OPM command (Table 2-11). Power measurements can be taken simultaneously with modulation measurements.
PM0	Turns off the Power Meter Measurement mode.

2-11 OUTPUT COMMANDS

Table 2-11 lists the output command mnemonic codes. These commands provide for the output of data from the signal generator to the controller. Figure 2-8 (page 2-47) shows examples of output command programming.

Table 2-11. Output Commands (1 of 5)

MNEMONIC CODE	FUNCTION
*IDN?	Causes the signal generator to return an identification string in IEEE-488.2 specified <NR1> format (four fields separated by commas). The fields are:<Manufacturer>, <Model>, <Serial #>, <Firmware revision level>; where the actual model number, serial number, and firmware version of the 682XXB/683XXB will be passed.
OI	Causes the signal generator to identify itself by sending the following parameter information over the bus; model number, low-end frequency, high-end frequency, minimum output power level, maximum output power level, software revision number, serial number, model prefix (A or B), and series (2 or 3). This command can be used to send parameter information to the controller automatically, thus relieving the operator from having to input the information manually. The string is 36 characters long.
OFL	Returns the low-end frequency value (in MHz) to the controller.
OFH	Returns the high-end frequency value (in MHz) to the controller.
OF0	Returns the F0 frequency value (in MHz) to the controller.
OF1	Returns the F1 frequency value (in MHz) to the controller.
OF2	Returns the F2 frequency value (in MHz) to the controller.
OF3	Returns the F3 frequency value (in MHz) to the controller.
OF4	Returns the F4 frequency value (in MHz) to the controller.
OF5	Returns the F5 frequency value (in MHz) to the controller.
OF6	Returns the F6 frequency value (in MHz) to the controller.
OF7	Returns the F7 frequency value (in MHz) to the controller.
OF8	Returns the F8 frequency value (in MHz) to the controller.
OF9	Returns the F9 frequency value (in MHz) to the controller.
OM0	Returns the M0 frequency value (in MHz) to the controller.

Table 2-11. Output Commands (2 of 5)

MNEMONIC CODE	FUNCTION
OM1	Returns the M1 frequency value (in MHz) to the controller.
OM2	Returns the M2 frequency value (in MHz) to the controller.
OM3	Returns the M3 frequency value (in MHz) to the controller.
OM4	Returns the M4 frequency value (in MHz) to the controller.
OM5	Returns the M5 frequency value (in MHz) to the controller.
OM6	Returns the M6 frequency value (in MHz) to the controller.
OM7	Returns the M7 frequency value (in MHz) to the controller.
OM8	Returns the M8 frequency value (in MHz) to the controller.
OM9	Returns the M9 frequency value (in MHz) to the controller.
OL0	Returns the L0 power value (in dBm) to the controller.
OL1	Returns the L1 power value (in dBm) to the controller.
OL2	Returns the L2 power value (in dBm) to the controller.
OL3	Returns the L3 power value (in dBm) to the controller.
OL4	Returns the L4 power value (in dBm) to the controller.
OL5	Returns the L5 power value (in dBm) to the controller.
OL6	Returns the L6 power value (in dBm) to the controller.
OL7	Returns the L7 power value (in dBm) to the controller.
OL8	Returns the L8 power value (in dBm) to the controller.
OL9	Returns the L9 power value (in dBm) to the controller.
OLO	Returns the Level Offset power value (in dB) to the controller.
ODF	Returns the ΔF frequency value (in MHz) to the controller.
OPD	Returns the dwell time of the power sweep (in ms) to the controller.
OPS	Returns the number-of-steps of the power sweep to the controller.
OSD	Returns the dwell time of the step sweep (in ms) to the controller.

Table 2-11. Output Commands (3 of 5)

MNEMONIC CODE	FUNCTION
OSS	Returns the number-of-steps of the step sweep to the controller.
OST	Returns the sweep time value (in ms) to the controller.
OAD1	Returns the internal AM depth value (in %) to the controller.
OAD2	Returns the internal AM depth value (in dB) to the controller.
OAR	Returns the internal AM rate (in Hz) to the controller.
OAW	Returns the name of the internal AM waveform ("SINE", "SQUARE WAVE", "RAMP UP", "RAMP DOWN", "GAUSSIAN NOISE", "UNIFORM NOISE", "TRIANGLE") to the controller.
OAS	Returns the external AM sensitivity value (in %/V) to the controller.
OAB	Returns the external AM sensitivity value (in dB) to the controller.
OAI	Returns the external AM impedance value (in Ω) to the controller.
OAE	Returns the name of the AM source ("FRONT", "REAR", "INTERNAL") to the controller.
OFD	Returns the internal FM deviation value (in Hz) to the controller.
OFR	Returns the internal FM rate (in Hz) to the controller.
OFW	Returns the name of the internal FM waveform ("SINE", "SQUARE WAVE", "RAMP UP", "RAMP DOWN", "GAUSSIAN NOISE", "UNIFORM NOISE", "TRIANGLE") to the controller.
OFK	Returns the internal or external FM lock status ("UNLOCKED NARROW", "UNLOCKED WIDE", "LOCKED") to the controller.
OFS	Returns the external FM sensitivity value (in MHz/V) to the controller.
OFI	Returns the external FM impedance value (in Ω) to the controller.
OFE	Returns the name of the FM source ("FRONT", "REAR", "INTERNAL") to the controller.
OPHD	Returns the internal ΦM deviation value (in radians) to the controller

Table 2-11. Output Commands (4 of 5)

MNEMONIC CODE	FUNCTION
OPHR	Returns the internal ΦM rate (in Hz) to the controller.
OPHW	Returns the name of the internal ΦM waveform ("SINE", "SQUARE WAVE", "RAMP UP", "RAMP DOWN", "GAUSSIAN NOISE", "UNIFORM NOISE", "TRIANGLE") to the controller.
OPHM	Returns the internal or external ΦM mode ("NARROW", "WIDE") to the controller.
OPHS	Returns the external ΦM sensitivity value (in radians/V) to the controller.
OPHI	Returns the external ΦM impedance value (in Ω) to the controller.
OPHE	Returns the name of the ΦM source ("FRONT", "REAR", "INTERNAL") to the controller.
OPR	Returns the internal pulse frequency (in MHz) to the controller.
OPP	Returns the internal pulse period (in μs) to the controller.
OPW, OW1	Returns the internal pulse width1 value (in μs) to the controller.
OW2	Returns the internal pulse width2 value (in μs) to the controller.
OW3	Returns the internal pulse width3 value (in μs) to the controller.
OW4	Returns the internal pulse width4 value (in μs) to the controller.
ODP, OD1	Returns the internal pulse delay1 value (in μs) to the controller.
OD2	Returns the internal pulse delay2 value (in μs) to the controller.
OD3	Returns the internal pulse delay3 value (in μs) to the controller.
OD4	Returns the internal pulse delay4 value (in μs) to the controller.
ODD	Returns the internal pulse stepped delay mode step size value (in μs) to the controller.
ODE	Returns the internal pulse stepped delay mode delay 1 stop value (in μs) to the controller.
ODL	Returns the internal pulse stepped delay mode dwell-time-per-step value (in ms) to the controller.
ODS	Returns the internal pulse stepped delay mode delay 1 start value (in μs) to the controller.

Table 2-11. Output Commands (5 of 5)

MNEMONIC CODE	FUNCTION
OMD	Returns the name of the internal pulse mode ("SINGLE", "DOUBLET", "TRIPLET","QUADRUPLET") to the controller.
OPC	Returns the internal pulse clock rate (in MHz) to the controller.
OPM	Returns the internal power meter measurement value (in dBm) to the controller.
OPT	Returns the name of the internal pulse trigger ("FREE RUN", "GATED", "DELAYED", "TRIGGERED", "TRIG WITH DELAY", "COMPOSITE") to the controller.
OP5	Returns the internal or external pulse polarity ("HIGH", "LOW") to the controller.
OP3	Returns the name of the pulse source ("FRONT", "REAR", "INTERNAL FRONT TRIG", "INTERNAL REAR TRIG") to the controller.
OMM	1. Returns the AM depth measurement value (in %) to the controller, when the AMI command either has been or is also programmed. 2. Returns the FM deviation measurement value (in MHz) to the controller, when the FMD command either has been or is also programmed.
OVN	Returns the ROM version number to the controller.
OWT	Returns the GPIB termination status to the controller. (0=CR; 1=CRLF)
OSE	Returns the last GPIB syntax error to the controller.
OEM	Returns the Extended SRQ Mask bytes (3 binary bytes) to the controller.
OES	Returns the GPIB Status bytes (3 binary bytes) to the controller.
OSB	Returns the Primary GPIB Status byte to the controller.
OSM	Returns the Primary SRQ Mask byte to the controller.
OSR	Returns the self-test results (6 binary bytes) to the controller.

```
760 OUTPUT 705;"OF1"
770 ENTER 705;A
780 PRINT "F1 is set at ";A;" MHz"


1050 OUTPUT 705;"OSS"
1060 ENTER 705;A
1070 PRINT "Step Sweep has ";A;" Steps"
```

Figure 2-8. Output Command Programming Examples

2-12 STORED SETUP COMMANDS

Table 2-12 (page 2-48) lists the stored setup command mnemonic codes. These commands provide for saving instrument setups and recalling them for use.

A current instrument setup can be saved to internal setup memory using the SSN($M_{1\ to\ 9}$) command, where M = memory locations 1 to 9. Up to nine instrument setups can be stored in this manner. The command RSN($M_{1\ to\ 9}$) recalls a stored instrument setup from internal setup memory locations 1 to 9.

If more than nine instrument setups are needed, or if it is desirable to store the setups in the controller instead of the signal generator memory, the 682XXB/683XXB can be commanded to output and accept stored setups over the bus.

The SAF command outputs the current instrument setup to the controller in a 3000-byte (approximately) binary data string. The controller stores the instrument setup. The RCF command readies the signal generator to receive a new instrument setup recalled from the controller. Figure 2-9 shows an example of SAF and RCF command programming.

The SAM and RCM commands perform the same functions as described for the SAF and RCF commands, except that all of the stored instrument setups are included in the binary data string along with the current instrument setup. For these commands, the binary data string is approximately 30000 bytes long.

Table 2-12. Stored Setup Commands

MNEMONIC CODE	FUNCTION
SAF	Outputs the current instrument setup to the controller.
SAM	Outputs both the current instrument setup and all stored instrument setups to the controller.
SM	Recalls the next stored instrument setup in sequence.
SSN(M_{1-9})	Saves the current instrument setup to internal setup memory location M, where M = 1 to 9.
RCF	Readies the 682XXB/683XXB to receive a new instrument setup recalled from the controller.
RCM	Readies the 682XXB/683XXB to receive a new instrument setup and new stored setups recalled from the controller.
RSN(M_{1-9})	Recalls the instrument setup stored in internal setup memory location M, where M = 1 to 9.

Programming Note: The SAF and SAM commands output binary data. The data string is terminated with "EOI" on the last byte sent (no CR or LF is sent).

```
10 DIM A$ [3000]
20 OUTPUT 705; "SAF"
30 ENTER 705 USING "#%, #%K"; A$ (Requires EOI
   to be the terminator of the read.)
40 OUTPUT 705; "RCF"; A$ (A$ must follow the SAF.)
```

Figure 2-9. SAF and RCF Commands Programming Example

2-13 SRQ AND STATUS BYTE COMMANDS

Table 2-13 (page 2-49) lists the Service Request (SRQ) and Status Byte command mnemonic codes. These commands enable the signal generator to request service from the controller when certain, predefined conditions exist.

Status Bytes

The 682XXB/683XXB has three GPIB status bytes—the primary and two extended status bytes. Figure 2-10 shows the three status bytes and identifies the status reporting function of each status byte bit.

Each status reporting bit, with the exception of primary status byte bit 6 (SRQ), is set when the condition on which it reports is detected. These changes in status byte bit settings can be read by the controller as follows:

- The contents of the primary status byte is returned to the controller in response to a serial poll or the OSB command.
- The contents of the primary status byte and the two extended status bytes are returned to the controller in response to the OES command. Figure 2-11 (page 2-50) shows an example of OES command programming.

SRQ Generation

The signal generator can generate GPIB service requests (SRQs) to report instrument status and syntax errors to the controller. The signal generator will generate an SRQ if:

1. The SRQ generation function has been enabled using the SQ1 command *and*,
2. One (or more) of the status reporting functions is true *and*,
3. The primary status byte bit associated with the true status reporting function has been enabled.

Bits in the primary status byte can be enabled by either of two methods. The first uses the FB1/FB0, ES1/ES0, UL1/UL0, LE1/LE0, PE1/PE0, SE1/SE0, and SB1/SB0 commands, described in Table 2-13, to individually enable or disable each bit. The second method uses a single 8-bit status byte mask (MB0) to enable any or all of the primary status byte bits.

Figure 2-12 (page 2-51) shows examples of status byte mask programming.

NOTE

All status byte bits are latched except for those indicated with the "*". Once set, an OES or OSB command must be received before the condition will be reset. The primary status byte bit 6 (SRQ) is cleared by a serial poll only.

Primary Status Byte

Extended Status Byte 2	SRQ	Syntax Error	Parameter Range Error	Lock Error	RF Unleveled	End of Sweep	Extended Status Byte 1
Bit 7 (128)	*Bit 6* (64)	*Bit 5* (32)	*Bit 4* (16)	*Bit 3* (8)	*Bit 2* (4)	*Bit 1* (2)	*Bit 0* (1)

Primary status byte bit 0 is set whenever one of the status conditions reported by an extended status byte 1 is true and the associated status bit is enabled. This bit is cleared when the controller sends the OES command.

Primary status byte bit 7 is set whenever one of the status conditions reported by an extended status byte 2 is true and the associated status bit is enabled. This bit is cleared when the controller sends the OES command.

Primary status byte bit 6 (SRQ) is not maskable. This bit is set by the SQ1 command and cleared by a serial poll.

Extended Status Byte 1

Not Used	Not Used	Not Used	Not Used	RF* Locked	Self Test Completed	Modulation Error	Self Test Failed
Bit 7 (128)	*Bit 6* (64)	*Bit 5* (32)	*Bit 4* (16)	*Bit 3* (8)	*Bit 2* (4)	*Bit 1* (2)	*Bit 0* (1)

Extended status byte 1 bits are enabled by the extended status byte 1 mask command, MB1.

Extended status byte 1 bit 0 (SelfTest Failed) and bit 2 (Self Test Complete) should not be unmasked at the same time.

Extended status byte 1 bit 3 (RF Locked) is only used with the Model 360B interface. The setting of this bit is blocked or unblocked by the commands, LS0 and LS1 (See Table 2-13).

Extended Status Byte 2

Parameter* Changed	Calibrate Function Finished	Not Used	RF* Unlocked	Crystal Oven Failure	Calibrate Function Failed	Not Used	Not Used
Bit 7 (128)	*Bit 6* (64)	*Bit 5* (32)	*Bit 4* (16)	*Bit 3* (8)	*Bit 2* (4)	*Bit 1* (2)	*Bit 0* (1)

Extended status byte 2 bits are enabled by the extended status byte 2 mask command, MB2.

The setting of extended status byte 2 bit 4 (RF Unlocked) is blocked or unblocked by the commands, EL0 and EL1 (See Table 2-13).

Extended status byte 2 bit 7 (Parameter Changed) is only used with the Model 562 interface. The setting of this bit is blocked or unblocked by the commands, II0 and II1 (See Table 2-13).

Figure 2-10. *Primary and Extended Status Bytes*

Table 2-13. SRQ and Status Byte Commands (1 of 2)

MNEMONIC CODE	FUNCTION
ES1	Enables an SRQ to be generated when Primary Status Byte bit 1 (End of Sweep) is set and SQ1 has been programmed.
ES0	Inhibits an SRQ from being generated when the End of Sweep bit is set. This is the default mode.
FB1	Enables an SRQ to be generated when Primary Status Byte bit 0 (Extended Status Byte 1) is set and SQ1 has been programmed. The Extended Status Byte 1 bit is set whenever one (or more) of the unmasked status reporting functions in Extended Status Byte 1 is true.
FB0	Inhibits an SRQ from being generated when the Extended Status Byte 1 bit is set. This is the default mode.
LE1	Enables an SRQ to be generated when Primary Status Byte bit 3 (Lock Error) is set and SQ1 has been programmed.
LE0	Inhibits an SRQ from being generated when the Lock Error bit is set. This is the default mode.
MB0	Sets an 8-bit data mask that is used to enable specific bits of the Primary Status Byte (Figure 2-12). This enables any or all of the bits (except for bit 6) in the Primary Status Byte to generate an SRQ using one 8-bit byte. This command can be equivalent to sending ES1, FB1, LE1, PE1, SE1, SB1, and UL1.
MB1	Sets the enable mask byte for Extended Status Byte 1.
MB2	Sets the enable mask byte for Extended Status Byte 2.
PE1	Enables an SRQ to be generated when Primary Status Byte bit 4 (Parameter Range Error) is set and SQ1 has been programmed.
PE0	Inhibits an SRQ from being generated when the Parameter Range Error bit is set. This is the default mode.
SB1	Enables an SRQ to be generated when Primary Status Byte bit 7 (Extended Status Byte 2) is set and SQ1 has been programmed. The Extended Status Byte 2 bit is set whenever one (or more) of the unmasked status reporting functions in Extended Status Byte 2 is true.
SB0	Inhibits an SRQ from being generated when the Extended Status Byte 2 bit is set. This is the default mode.
SE1	Enables an SRQ to be generated when Primary Status Byte bit 5 (Syntax Error) is set and SQ1 has been programmed.

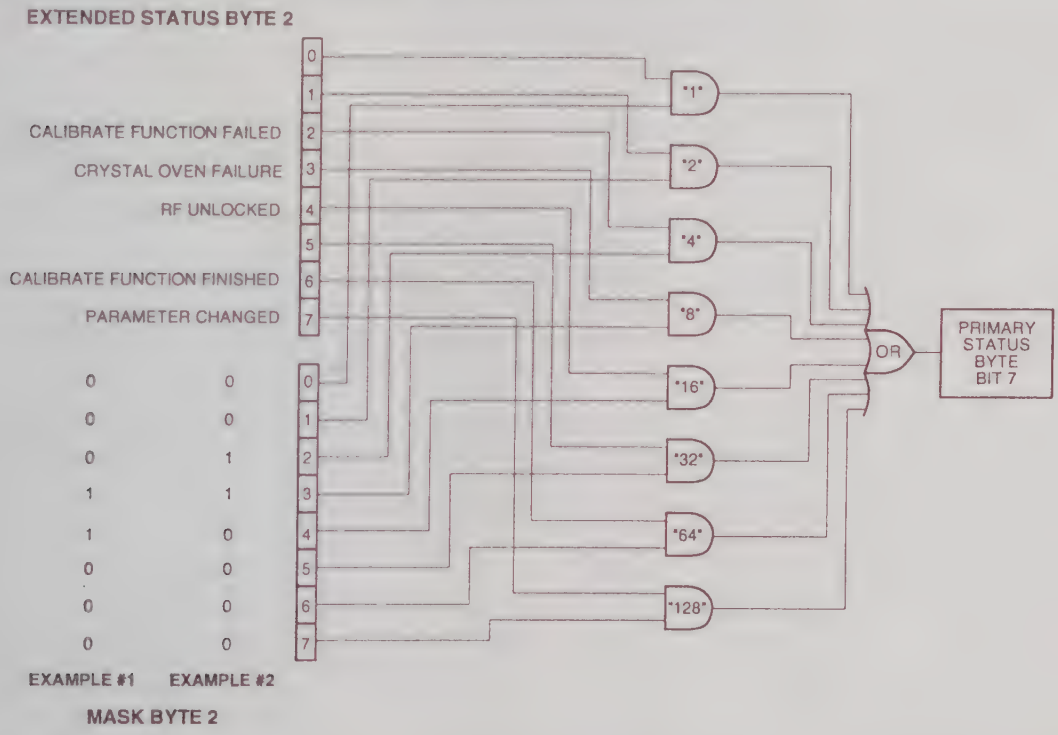
Table 2-13. SRQ and Status Byte Commands (2 of 2)

MNEMONIC CODE	FUNCTION
SE0	Inhibits an SRQ from being generated when the Syntax Error bit is set. This is the default mode.
SQ1	Enables the SRQ generation function. This command allows a status reporting function, that is true and enabled, to pull the SRQ line LOW (true) and request service from the controller.
SQ0	Disables the SRQ generation function. This is the default mode.
UL1	Enables an SRQ to be generated when Primary Status Byte bit 2 (RF Unleveled) is set and SQ1 has been programmed.
UL0	Inhibits an SRQ from being generated when the RF Unleveled bit is set. This is the default mode.
LS1	Unblocks updating of the Extended Status Byte 1 bit 3 (RF Locked). This bit is only used with the Model 360B interface.
LS0	Disables updating of the Extended Status Byte 1 bit 3. This is the default setting.
EL1	Unblocks updating of the Extended Status Byte 2 bit 4 (RF Unlocked).
EL0	Blocks updating of the Extended Status Byte 2 bit 4. This is the default setting because it is normal for the RF to be momentarily unlocked during sweeps and sweep retrace.
II1	Unblocks updating of the Extended Status Byte 2 bit 7 (Parameter Changed). This bit is only used with the Model 562 interface. This bit is cleared when the 562 sends the OCP command (Output Last Parameter Changed).
II0	Disables updating of the Extended Status Byte2 bit 7. This is the default setting.
CSB	Clears all GPIB status bytes.

```
OUTPUT 705; "OES"
ENTER 705 USING "#, B"; A, B, C
MAIN = A
1 EXT = B
2 EXT = C
```

Figure 2-11. OES Command Programming Example

The 682XXB/683XXB has a software mask that permits manipulation of the three status bytes over the bus. This manipulation is accomplished by sending the command codes MB0, MB1, MB2, or all three at once, followed by an argument that assigns an on/off condition for each bit in the byte. Two examples are shown below:



EXAMPLE #1: `"MB2" (CHR $(24))`

Sets bits 3 and 4 in Mask Byte 2 to 1 and all other bits to 0, thus enabling bits 3 and 4 in Extended Status Byte 2 to be read from the bit 7 position of the Primary Status Byte.

EXAMPLE #2: `"MB2" (CHR $(12))`

Sets bits 2 and 3 in Mask Byte 2 to 1 and all other bits to 0, thus enabling bits 2 and 3 in Extended Status Byte 2 to be read from the bit 7 position of the Primary Status Byte.

Figure 2-12. *Status Byte Mask Programming Examples*

2-14 CONFIGURATION COMMANDS

Table 2-14 lists the configuration command mnemonic codes. These commands permit selection/setting of the following system configuration items via the bus:

- A +5V or –5V level for the rear panel retrace and bandswitch blanking outputs.
- A TTL-low or TTL-high signal to turn RF on during pulse moduation.
- Setting the frequency scaling reference multiplier value.
- Normally-open or normally-closed contacts on the internal penlift relay.
- RF on or RF off during frequency switching in CW and step sweep modes.
- RF on or RF off during sweep retrace.
- RF on or RF off at reset.
- 40 dB or 0 dB of attenuation when RF is switched off in units with a step attenuator (Option 2).

The system configuration selections made with GPIB commands remain in effect when the instrument is returned to local control.

Table 2-14. *Configuration Commands (1 of 2)*

MNEMONIC CODE	FUNCTION
BPN	Selects a –5V level for the retrace and bandswitch blanking outputs. (The retrace blanking output signal is available at pin 6 of the AUX I/O connector; the bandswitch blanking output signal at pin 20 of the AUX I/O connector.)
BPP	Selects a +5V level for the retrace and bandswitch blanking outputs.
EP0	Selects TTL-low to turn RF on during pulse modulation.
EP1	Selects TTL-high to turn RF on during pulse modulation.
FRS	Permits setting the frequency scaling reference multiplier value. The multiplier value must be between 0.1 to 14 and must be terminated with TMS. ***Programming Example:*** Programming "**FRS 3 TMS**" sets the frequency scaling reference multiplier to 3. This command affects all entered and displayed frequencies, but does not affect the output of the instrument.
PPO	Selects normally-open contacts on the internal penlift relay. (The penlift relay output, optionally available at the rear panel, is used to lift a plotter pen during retrace.)
PPC	Selects normally-closed contacts on the internal penlift relay.

Table 2-14. Configuration Commands (2 of 2)

MNEMONIC CODE	FUNCTION
RC0	Selects RF to be off during frequency switching in CW and step sweep modes.
RC1	Selects RF to be on during frequency switching in CW and step sweep modes.
RT0	Selects RF to be off during retrace.
RT1	Selects RF to be on during retrace.
RO0	Selects RF to be on at reset. (This is the default mode.)
RO1	Selects RF to be off at reset.
TR0	Sets 0 dB of attenuation when RF is switched off in units with a step attenuator (Option 2) installed. If Option 2 is not installed, this command produces a syntax error.
TR1	Sets 40 dB (minimum) of attenuation when RF is switched off in units with a step attenuator (Option 2) installed. This provides a better output source match. If Option 2 is not installed, this command produces a syntax error.

2-15 GROUP EXECUTE TRIGGER COMMANDS

Table 2-15 lists the group execute trigger (GET) command mnemonic codes. These commands let a GET bus message (Table 1-3) be used to trigger certain signal generator functions and thus speed up bus operations.

In the default state, the 682XXB/683XXB responds to a GET message by triggering a single sweep.

Table 2-15. Group Execute Trigger Commands

MNEMONIC CODE	FUNCTION
GTC	Configures the 682XXB/683XXB to execute a SQF command (scan to the next higher preset CW frequency) each time a GET message is received.
GTD	Configures the 682XXB/683XXB to execute a DN command (steps the open parameter down by the step size) each time a GET message is received.
GTF	Configures the 682XXB/683XXB to execute a fast-frequency-switching step (Table 2-16) each time a GET message is received.
GTL	Configures the 682XXB/683XXB to execute a TSS command (steps to the next point in a dual step sweep mode) each time a GET message is received.
GTO	Disables the GET functions.
GTS	Configures the 682XXB/683XXB to execute a TRS command (trigger a single sweep) each time a GET message is received. This is the default mode.
GTT	Configures the 682XXB/683XXB to execute a TST command (execute a complete signal generator self test) each time a GET message is received.
GTU	Configures the 682XXB/683XXB to execute a UP command (steps the open parameter up by the step size) each time a GET message is received.
Y	Sending a "Y" is equivalent to sending a GET.

2-16 FAST-FREQUENCY-SWITCHING COMMANDS

Table 2-16 lists the fast-frequency-switching command mnemonic codes. These commands provide for reducing the time that it takes to switch between two CW frequencies.

In the fast-frequency-switching mode, up to 1000 frequencies can be loaded into a stack. A stack pointer can then be set to point to a specific frequency on the stack and the signal generator commanded to switch from that frequency through the following stack frequencies to the bottom of the stack. Figure 2-13 provides an example of fast-frequency-switching programming.

Table 2-16. Fast-Frequency-Switching Commands

MNEMONIC CODE	FUNCTION
ZL($X_{000-999}$)	Loads a CW frequency into the stack at location X. The location is a number from 000 to 999.
ZEL	Ends frequency loading.
ZS($X_{000-999}$)	Sets the stack pointer to point to location X. The location is a number from 000 to 999.

```
OUTPUT 705; "ZL000" . . . Set pointer for load
OUTPUT 705; "10 GH, 11 GH, 12 GH, 13 GH"
OUTPUT 705; "ZEL GTF"
NEW
OUTPUT 705; "ZS000" . . . Set pointer to start
TRIGGER 705;      . . . . Sets 10 GHz
TRIGGER 705;      . . . . Sets 11 GHz
TRIGGER 705;      . . . . Sets 12 GHz
TRIGGER 705;      . . . . Sets 13 GHz
GO TO NEW
```

Figure 2-13. Fast-Frequency-Switching Programming Example

2-17 POWER-OFFSET-TABLE COMMANDS

Table 2-17 lists the power-offset-table command mnemonic codes. These commands provide for maintaining a consistent power level at a point within a test setup across the measurement frequencies. This "flattening" of the test point power level is accomplished by summing a power offset word (from the power offset table) with the signal generator's normal power level DAC word at each frequency point.

The power-offset mode works in conjunction with the fast-frequency-switching mode (paragraph 2-16). The frequency stack must be loaded before loading the power-offset table because the frequency loading sets the upper limit for the number of entries in the power-offset table. The same pointer is used for both the frequency stack and the power-offset table. Once the power-offset table is loaded, the PT1 command turns on the power-offset mode; the PT0 command turns it off.

Loading the Power-Offset Table

To load the power-offset table, use the command, PTL clch dldh....., where "clch" is the number of power-offset words and "dldh" is a power-offset word. Both "clch" and "dldh" are two-byte binary words sent LOW byte first and HIGH byte second. The power-offset word is in hundreths of a dB. Negative power offsets use twos-complement representation.

To change a power-offset word in the table, use the PTC dldh command, where "dldh" is the new power-offset word for the current power level setting.

Programming Note:
Care must be taken to send the exact number of power-offset words specified in the wordcount, "clch". If too few words are sent, the GPIB interface may not respond properly.

Figures 2-14 and 2-14a show an example of power-offset mode programming.

Table 2-17. *Power-Offset-Table Commands*

MNEMONIC CODE	FUNCTION
PT0	Disable the Power Offset Table
PT1	Enable the Power Offset Table
PTC	Change a Power Offset Table entry (PTC dldh), where dldh is the new offset word for the current table entry.
PTL	Load a Power Offset Table (PTL clch dldh ...), where clch is the data word count and dldh is the data word.

The following is an example of power-offset mode programming. This program is written for use with an IBM-PC type computer/controller containing an IOtech GPIB interface.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

/* IOtech Driver488/LIB Subroutine Interface definitions... */
#include "\ieee488\iotlib.h"
#include "\ieee488\iot_main.h"

/* Define the device handles */
DevHandleT Synth,ieee;

void main()
{
  char CmdString[10], DataString[40], String[40];
  unsigned char XString[160];

  int  next_step,i,j;

  /*****************************************************************************/
  /* Initialize the IOtech interface board and */
  /* obtain the interface's handle.            */

  #define  ADDRESS 5

  if((ieee=InitIeee488(btMP488CT, 21, -1, 0x02e1, 7, 5, 1, 10000,0))==-1)
     {
     printf("Cannot initialize IEEE 488 system.\n")
     exit(1);
     }

  if(( Synth=CreateDevice( ADDRESS, -1 ) )==-1)
     {
     printf("Cannot create Synth device.\n");
     exit(1);

  /* Set the device timeout so you don't wait forever if there's a problem */
  TimeOut(Synth, 2000);

  /* Handle the errors in the program */
  Error(Synth,OFF);

  /*****************************************************************************/

  /* Address the Synthesizer to listen */
```

NOTE: This program is continued in Figure 2-14a.

Figure 2-14. *Power-Offset Mode Programming Example (1 of 2)*

```
    strcpy(XString,"_?U%");
    SendCmd(Synth,XString,strlen(XString));

    Output(Synth,"RST");
    Output(Synth,"GTF");
    Output(Synth,"ZL000");
    Output(Synth,"1 GH 2 GH 3 GH 4 GH 5 GH 6 GH 7 GH 8 GH 9 GH 10 GH");
    Output(Synth,"ZEL");

    /* Make a data array with the PTL command, the word count */
    /* and the binary data in low-byte, high-byte order.      */
    DataString[0]='P';
    DataString[1]='T';
    DataString[2]='L';
    DataString[3]=10;       /* Low byte  -  ten words */
    DataString[4]=0;        /* High byte -            */
    DataString[5]=0;        /* 0 */
    DataString[6]=0;
    DataString[7]=20;       /* 276 */
    DataString[8]=1;
    DataString[9]=30;       /* 542 */
    DataString[10]=2;
    DataString[11]=40;      /* 808 */
    DataString[12]=3;
    DataString[13]=50;      /* 1074 */
    DataString[14]=4;
    DataString[15]=60;      /* 1340 */
    DataString[16]=5;
    DataString[17]=70;      /* 1606 */
    DataString[18]=6;
    DataString[19]=80;      /* 1872 */
    DataString[20]=7;
    DataString[21]=90;      /* 2138 */
    DataString[22]=8;
    DataString[23]=100;     /* 2404 */
    DataString[24]=9;

    /* Send the data with an EOI on the last byte */
    SendEoi(Synth,DataString,25);

    Output(Synth,"PT1");
    Output(Synth,"ZS000");

    for(next_step=0;next_step<10;next_step++)
      {
        Output(Synth,"Y");
        printf("Press Enter for Next Frequency");
        getchar();
      }

} /* End of main() */
```

Figure 2-14a. Power-Offset Mode Programming Example (2 of 2)

2-18 USER LEVEL CALIBRATION COMMANDS

Table 2-18 lists the user level calibration commands. These commands provide for (1) activating individual user level calibration tables, (2) sending the tables to the controller, and (3) recalling the tables from the controller.

The user level (flatness correction) calibration function provides for calibrating out path variations in a test setup. This is accomplished by means of an entered power-offset table from a GPIB power meter or calculated data. When the user level calibration table is activated, the set power level is delivered to the point in the test setup where the calibration was performed. Up to five user level calibration tables from 2 to 801 frequency points/table can be created and stored in signal generator's memory for recall. (Refer to Chapter 3 of the 682XXB/683XXB Operation Manual for user level calibration procedures.)

The commands, LU1 thru LU5, each activate an individual user level calibration table (#1 thru #5). The LU0 command turns off the active user level calibration table. The LUS command sends all five tables of user level calibration data to the controller where they are stored in a binary data file. While stored in the file, the data can be edited (see page 2-64). The LUR command readies the 682XXB/683XXB to receive the five tables of user level calibration data from the controller. Figures 2-15 thru 2-15b show an example program for saving and recalling user level calibration tables.

Table 2-18. User Level Calibration Commands

MNEMONIC CODE	FUNCTION
LU0	Turns off the active user level calibration table.
LU1	Activates user level calibration table #1. Turns off any other active user level calibration table.
LU2	Activates user level calibration table #2. Turns off any other active user level calibration table.
LU3	Activates user level calibration table #3. Turns off any other active user level calibration table.
LU4	Activates user level calibration table #4. Turns off any other active user level calibration table.
LU5	Activates user level calibration table #5. Turns off any other active user level calibration table.
LUR	Readies the 682XXB/683XXB to receive five tables of user level calibration data from the controller.
LUS	Sends all five tables of user level calibration data to the controller.

The following is an example program for saving and recalling user level calibration tables. This program uses the National Instruments NI-288.2 C language interface library (mcib.lib) and header (decl.h).

```
#include <stdio.h>
#include "decl.h"

void gpiberr(char *);

#define BOARD_ID         0
#define USER_LVL_SAVE        1
#define USER_LVL_RECALL      2
#define USER_LVL_NUM_BYTES   8232

void main()
{

Addr4882_t      source_addr = 5
                device_addr[2] = {5, NOADDR};
unsigned char   user_lvl_tables[USER_LVL_NUM_BYTES];
init            user_lvl_received,
               user_input;
FILE            *fp_user_lvl_data:


/** Clear the bus and take control.
 **/
SendIFC(BOARD_ID);
if(ibsta & ERR)
     gpiberr("SendIFC error");


/** Set the remote enable line.
 **/
EnableRemote(BOARD_ID, device_addr);
if(ibsta & ERR)
     gpiberr("EnableRemote error");


/** Prompt the user to save or recall the data.
 **/
printf("1. Save the data from the source\n");
printf("2. Recall the data to the source\n");
printf("Option: ");

scanf("%d",&user_input);

if(user_input == USER_LVL_SAVE)
     {
```

NOTE: This program is continued in Figure 2-15a.

Figure 2-15. *Programming Example of Saving and Recalling User Level Calibration Tables (1 of 3)*

```
        /** The LUS command tells the source to send the user level
          ** table data over the bus.
         **/
        Send(BOARD_ID, source_addr, "LUS\r\n", 5L, DABend);
        if(ibsta & ERR)
             gpiberr("Send error");

        /** Receive the user level table data.
         **/
        printf("Receiving data from the source\n");
        Receive(BOARD_ID, source_addr, user_lvl_tables,
                 (long)USER_LVL_NUM_BYTES, STOPend);
        if(ibsta & ERR)
             gpiberr("Receive error");

        user_lvl_received = ibcntl;
        printf("Received %d bytes of user level data\n",
                 user_lvl_received);

        /** Open binary data file and output the data.
         **/
        if((fp_user_lvl_data = fopen("userlvl.dat","w+b")) == NULL)
             {
             printf("Can't open the userlvl.dat data file\n");
             }
        else
             {
             printf("Outputting to userlvl.dat in the current
                       directory\n");
             fwrite(user_lvl_tables, sizeof(user_lvl_tables[0]),
                      USER_LVL_NUM_BYTES, fp_user_lvl_data);
             }
        }
else
        {
        /** Open the binary data file and read the data.
         **/
        if((fp_user_lvl_data = fopen("userlvl.dat","rb")) == NULL)
             {
             printf("Can't open the userlvl.dat data file\n");
             }
        else
             {
             printf("Inputting from userlvl.dat in the current
                       directory\n");
             fread(user_lvl_tables, sizeof(user_lvl_tables[0]),
                     USER_LVL_NUM_BYTES, fp_user_lvl_data);
             }
```

NOTE: This program is continued in Figure 2-15b.

Figure 2-15a. *Programming Example of Saving and Recalling User Level Calibration Tables (2 of 3)*

```
        /** The LUR command readies the source to receive the user
          ** level table data. Notice that there is no carriage
          ** return, line feed, or EOI sent with the LUR command.
         **/
        Send(BOARD_ID, source_addr, "LUR", 3L, NULLend);
        if(ibsta & ERR)
             gpiberr("Send error; LUR");

        /** The data is sent to the source immediately following the
          ** LUR command.
         **/
        printf("Sending %d bytes of data to the source\n",
                 USER_LVL_NUM_BYTES);
        Send(BOARD_ID, source_addr, user_lvl_tables,
             (long)USER_LVL_NUM_BYTES, DABend);
        if(ibsta & ERR)
             gpiberr("Send error; data");
        }

fclose(fp_user_lvl_data);
exit(0);
}/** end of main **/


/*****************************************************************************************
***Name: gpiberr
**Desc: Display error code and message for all GPIB operation
**Receives: errsta - the error string to display
**Returns: nothing
**/
void gpiberr(char *errstr)
{
printf("\n%s\nError code = %d\n",errstr,iberr);
}/** end of gpiberr **/
```

Figure 2-15b. Programming Example of Saving and Recalling User Level Calibration Tables (3 of 3)

Editing the Table Data

While stored in the binary data file of the controller, the data of the five user level calibration tables can be edited. An editor that can display the data file in hexadecimal will be needed to perform the edit.

Types of Data Storage Methods

There are three types of data storage methods used for user level calibration data. Each is described in the following paragraphs. (The data item descriptions will refer back to these data types.)

Double:

8 bytes. Most significant byte first.
ANSI/IEEE-754 64-bit floating point format.

|S| ←—E—→| ←————F————→|

where:

S (1 bit) = sign bit, 0 positive, 1 negative
E (11 bits) = exponent, biased by 1023 base 10
F (52 bits) = fraction, 0 ≤F <1

value = [(–1) raised to the S power] ×
[2 raised to the (E – 1023) power] ×
[1 + F]

Example:

801 is stored as 40 89 08 00 00 00 00 00, base 16.
S = 0
E = 408 base 16 = 1032 base 10
F = 0.908 base 16 = 0.564453125 base 10
801 = 1 × 512 × 1.564453125

Integer:

4 bytes. Most significant byte first.
Stored as a signed integer. The sign bit is the most significant bit. Negative numbers are stored in 2's complement form.

Example:

7025 is stored as 00 00 1B 71, base 16.
–7025 is stored as FF FF D4 8F, base 16 2's complement.

Short:

2 bytes. Most significant byte first.
Stored as a signed short. The sign bit is the most significant bit. Negative numbers are stored in 2's complement form.

Example:

350 is stored as 01 5E, base 16.
–350 is stored as FE A2, base 16.

Data Item Descriptions

Each data item contained in the binary data file is described below with the following information:

- Data name
- Description
- Type of data storage
- Offset into the data file for each user level calibration table
- Data units

Figure 2-16 (page 2-66) shows a printout of a section of the data file that contains each of these data items for user level calibration table #2.

Name: Start Frequency
Description: The starting frequency for each user level calibration.
Type: Double
Offsets (base 16): Table #1 **0006**
Table #2 **0674**
Table #3 **0CE2**
Table #4 **1350**
Table #5 **19BE**
Units: mHz (millihertz)

Name: Stop Frequency
Description: The ending frequency for each user level calibration.
Type: Double
Offsets (base 16): Table #1 **000E**
Table #2 **067C**
Table #3 **0CEA**
Table #4 **1358**
Table #5 **19C6**
Units: mHz (millihertz)

Name: Frequency Increment
Description: The frequency increment for 1 point. This value = (stop frequency – start frequency) divided by the number of points.
Type: Double
Offset (base 16): Table #1 **0016**
Table #2 **0684**
Table #3 **0CF2**
Table #4 **1360**
Table #5 **19CE**
Units: mHz (millihertz)

Name: Number of Points
Description: The number of frequency points.
Type: Double
Offsets (base 16): Table #1 **001E**
Table #2 **068C**
Table #3 **0CFA**
Table #4 **1368**
Table #5 **19D6**
Units: a value of 1 = 1 point

Name: Level Correction Offset
Description: This is the power level that is added to the front panel power before the level correction point table power levels are subtracted. It represents the maximum power deviations read during the calibration.
Type: Integer
Offsets (base 16): Table #1 **0026**
Table #2 **0694**
Table #3 **0D02**
Table #4 **1370**
Table #5 **19DE**
Units: mdB (milli-dB)

Name: Level Correction Point Table
Description: These are the power level correction values with respect to the maximum power deviation read during the calibration.
Type: Short (Array of 801 Points)
Offsets (base 16): Table #1 **002A**
Table #2 **0698**
Table #3 **0D06**
Table #4 **1374**
Table #5 **19E2**
Units: mdB (milli-dB)

```
000640   00 00 00 00   00 00 00 00   00 00 00 00   00 00 00 00
000650   00 00 00 00   00 00 00 00   00 00 00 00   00 00 00 00
000660   00 00 00 00   00 00 00 00   00 00 00 00   00 00 BA BE
000670   00 00 DA BE   42 7D 1A 94   A2 00 00 00   42 A2 30 9C
000680   E5 40 00 00   42 6D 1A 94   A2 00 00 00   40 22 00 00
000690   00 00 00 00   00 00 17 83   FF 11 FF 56   FF 56 FF 74
0006A0   FF 93 FF 9C   FF F6 00 00   FF C4 D1 21   E8 37 00 00
0006B0   00 00 00 00   00 00 00 00   00 00 00 00   00 00 00 00
0006C0   00 00 00 00   00 00 00 00   00 00 00 00   00 00 00 00
0006D0   00 00 00 00   00 00 00 00   00 00 00 00   00 00 00 00
```

Printout Explanation

The printout shows a section of the user level calibration data file, in hexadecimal, that contains each of the data items for user level calibration table #2. The offset into the data file is shown at the left in the printout.

Offset **0674**: Start Frequency
42 7D 1A 94 A2 00 00 00 = 2 GHz

Offset **067C**: Stop Frequency
42 A2 30 9C E5 40 00 00 = 10 GHz

Offset **0684**: Frequency Increment
42 6D 1A 94 A2 00 00 00 = 1 GHz

Offset **068C**: Number of Points
40 22 00 00 00 00 00 00 = 9 points

Offset **0694**: Level Correction Offset
00 00 17 83 = 6.016 dB

Offset **0698**: Level Correction Point Table (9 points)
FF 11 = –0.239 dB
FF 56 = –0.170 dB
FF 56 = –0.170 dB
FF 74 = –0.140 dB
FF 93 = –0.109 dB
FF 9C = –0.100 dB
FF F6 = –0.010 dB
00 00 = 0 dB
FF C4 = –0.060 dB

Figure 2-16. *Printout of a Section of the User Level Calibration Binary Data File*

2-19 MASTER-SLAVE OPERATION COMMANDS

Table 2-19 lists the master-slave operation command mnemonic codes. These commands provide for enabling two 68XXXBs that are connected in a master-slave configuration to produce CW and synchronized, swept output signals at a frequency offset.

In a master-slave configuration, one 68XXXB (the Master) controls the other (the Slave) via interface cables between their rear panel AUX I/O and SERIAL I/O connectors. The two units are phase-locked together by connecting them to the same 10 MHz reference time base. (Refer to the 682XXB/683XXB Operation Manual, Chapter 7—Use With Other Instruments, for master-slave interconnection and operating instructions.)

The parameter entry commands, SLF0 - SLF9 and SLM0 - SLM9, are used to set the F0 - F9 and M0 - M9 frequencies for the Slave 68XXXB; the SLDF parameter entry command is used to set the ΔF parameter for the Slave instrument. The main output power level (L1) for the Slave unit is set using the SLV or SLL1 parameter entry command; the alternate sweep power level (L2) for the Slave unit is set using the SLL2 parameter entry command. The S1 command turns on the master-slave mode of operation; the S0 command turns off the Master-Slave mode of operation.

Programming Example:
Programming "**`SLF1 5 GH SLF2 8 GH SLL1 3 DM S1`**" sets the Slave 68XXXB F1 frequency to 5 GHz, its F2 frequency to 8 GHz, and its output power level to 3 dBm and turns on the master-slave mode of operation. Now, when the Master 68XXXB is programmed to perform a F1 to F2 sweep, the Slave unit will produce a synchronous 5 GHz to 8 GHz frequency sweep that has an output power level of 3 dBm.

Programming Note:
Use the SOF parameter entry command *only* to set the frequency offset for a Slave unit that is (1) slave to a Master 68XXXB that is connected to a 360B VNA in a source or dual-source configuration or (2) slave to a Master 68XXXB that is programmed to perform non-sequential frequency step sweeps (refer to Special Step Sweep on page 2-22).

Table 2-19. *Master-Slave Operation Commands*

MNEMONIC CODE	FUNCTION
S0	Turns off the Master-Slave mode of operation.
S1	Turns on the Master-Slave mode of operation.

2-20 SELF TEST COMMAND

Table 2-20 lists the self test command mnemonic code. This command provides for executing a signal generator self test.

When a TST command is received, the signal generator performs a self test, then places a "P" (for pass) or a "F" (for fail) on the bus. It also generates six self test results bytes. Figure 2-18 (page 2-70) shows the six self test results bytes and identifies the reporting function of each bit.

When self test is completed, bit 7 of Self Test Results Byte 6 and bit 2 of Extended Status Byte 1 are both set. If a failure(s) occurs during self test, the Self Test Results Byte bit(s) reporting the failure(s) and bit 0 of Extended Status Byte 1 are set.

The OSR command returns the six self test results bytes to the controller. Figure 2-17 provides an example of self test command programming.

Programming Note: The "P or "F" character placed on the bus by the signal generator self test must be cleared from the output buffer (read by the controller) before another output command, such as OSR, is sent. If it is not cleared, the first character of the next output will be missing. Line 30 (Figure 2-17) shows clearing of the "P" or "F" character.

Table 2-20. *Self Test Command*

MNEMONIC CODE	FUNCTION
TST	Executes a signal generator self test. Extended Status Byte 1 bit 0 is set if self test fails; bit 2 is set when self test is complete.

```
10 OUTPUT 705; "CSB"
20 OUTPUT 705; "TST"
30 ENTER 705; D$
40 DISP D$
50 OUTPUT 705; "OSR"
60 ENTER 705 USING "#,B"; A, B, C, D, E, F
70 DISP A; B; C; D; E; F
80 END
```

Figure 2-17. *Self Test Command Programming Example*

Self Test Results Byte 1

Bit 7 (128)	Bit 6 (64)	Bit 5 (32)	Bit 4 (16)	Bit 3 (8)	Bit 2 (4)	Bit 1 (2)	Bit 0 (1)
Sweep Time Circuitry Failed	A18 Power Supply is Not Locked	Power Supply Voltage(s) are Out of Reg	Internal AM Failed	AM Meter Failed	DVM –10 Volt Reference Check Failed	DVM +10 Volt Reference Check Failed	DVM Ground Offset Check Failed

Self Test Results Byte 2

Bit 7 (128)	Bit 6 (64)	Bit 5 (32)	Bit 4 (16)	Bit 3 (8)	Bit 2 (4)	Bit 1 (2)	Bit 0 (1)
Not Locked Indicator Check Failed	Down Converter is Not Locked	YIG Loop Circuitry is Not Locked	Coarse Loop Circuitry is Not Locked	Fine Loop Circuitry is Not Locked	High Stability Crystal is Not Locked	Ext 10 MHz is Not Locked	Oven is Not Ready

Self Test Results Byte 3

Bit 7 (128)	Bit 6 (64)	Bit 5 (32)	Bit 4 (16)	Bit 3 (8)	Bit 2 (4)	Bit 1 (2)	Bit 0 (1)
Detector Log Amp Circuitry Failed	Level Reference Circuitry Failed	Not Leveled Detector Circuitry Failed	Delta-F Ramp Circuitry Failed	Center Frequency Circuitry Failed	Marker Switch Point Circuitry Failed	Linearizer Circuitry Failed	FM Loop Gain Circuitry Failed

Self Test Results Byte 4

Bit 7 (128)	Bit 6 (64)	Bit 5 (32)	Bit 4 (16)	Bit 3 (8)	Bit 2 (4)	Bit 1 (2)	Bit 0 (1)
3.3 - 5.5 GHz Switch Filter Section or Level Detector Circuitry Failed	2-3.3 GHz Switch Filter Section or Level Detector Circuitry Failed	Switch Filter or Level Detector Circuitry Failed	0.01 - 2 GHz Range Unleveled	A10 Q5 or Associated Circuitry Failed	2 - 8.4 GHz Range Unleveled and Not Locked	8.4 - 20 GHz Range Unleveled and Not Locked	2 - 20 GHz Range Unleveled and Not Locked

Self Test Results Byte 5

Bit 7 (128)	Bit 6 (64)	Bit 5 (32)	Bit 4 (16)	Bit 3 (8)	Bit 2 (4)	Bit 1 (2)	Bit 0 (1)
32 - 40 GHz Section of Switched Doubler Module Failed	Switched Doubler Module or Driver Circuitry Failed	Not Used	Not Used	Modulator or Driver Circuitry on A9 Failed	13.25 - 20 GHz Switch Filter Section or Level Detector Circuitry Failed	8.4 - 13.25 GHz Switch Filter Section or Level Detector Circuitry Failed	5.5 - 8.4 GHz Switch Filter Section or Level Detector Circuitry Failed

Self Test Results Byte 6

Bit 7 (128)	Bit 6 (64)	Bit 5 (32)	Bit 4 (16)	Bit 3 (8)	Bit 2 (4)	Bit 1 (2)	Bit 0 (1)
Self Test is Complete	Internal Pulse Reference Failed	Internal FM Failed	RF Was Off When Self Test Started	Slope DAC or Associated Circuitry Failed	Sample and Hold Circuitry Failed	20 - 25 GHz Section of Switched Doubler Module Failed	25 - 32 GHz Section of Switched Doubler Module Failed

Figure 2-18. *Self Test Results Bytes*

2-21 MISCELLANEOUS COMMANDS

Table 2-21 is a list of miscellaneous command mnemonic codes that do not fit into any of the other classifications. These commands provide the following operations:

- GPIB Address Change
- CW Ramp
- Secure Mode
- Returning the 682XXB/683XXB to local control
- Instrument Reset
- Serial Number Entry

Table 2-21. Miscellaneous Commands

MNEMONIC CODE	FUNCTION
ADD	Permits changing of the instrument GPIB address. The address must be between 1 and 30 and must be terminated with ADR. ***Programming Example:*** Programming "**ADD 13 ADR**" changes the instrument GPIB address to 13.
CS0	Turns off the CW ramp.
CS1	Turns on the CW ramp. This produces a repetitive 0V to 10V ramp output to the rear panel HORIZ OUT connector and pin 1 of the AUX I/O connector.
DS0	Turns on the secure mode. This blanks the front panel display of all frequency, power level, and modulation parameters.
DS1	Turns off the secure mode and restores the front panel display of all frequency, power level, and modulation parameters.
RL	Returns the 682XXB/683XXB to local (front panel) control.
RST	Resets the 682XXB/683XXB to its default settings. **NOTE** Sending this command clears the current instrument setup. If this setup is needed for future testing, save it as a stored setup (paragraph 2 -12) before sending RST.
SNR	Permits entry of the instrument serial number (SNRnnnnnnX). The serial number, represented by nnnnnn, must be six characters in length.

2-22 PROGRAM ERRORS

Two types of errors can occur in bus programming—invalid-parameter and syntax. These two error types are described in the following paragraphs.

Invalid-Parameter

Invalid-parameter errors are those that cause the signal generator to beep. These errors include:

- Programming an analog frequency sweep where the sweep start frequency is greater than the stop frequency.
- Attempting to enter a frequency, time, or power level parameter that exceeds the limits of the signal generator.
- Failing to properly end a parameter entry with a suitable terminator such as MH, DB, MS, etc.

Syntax

Syntax errors are those that occur in the formulation of a program statement, such as writing **"EXTTFS"** instead of **"EXTTRS"**.

To prevent misinterpretation of command statements, the signal generator ignores all portions of the command statement following the syntax error.

All commands are ignored until the signal generator receives the Unlisten command (ASCII 63; "?" character) over the bus or until the signal generator is addressed to talk.

2-23 RESET PROGRAMMING AND DEFAULT CONDITIONS

Table 2-22 describes the five methods that can be used to reset the signal generator GPIB interface. They provide a means for quickly returning the 682XXB/683XXB to its default (preprogrammed) operational state.

The default settings for the numeric frequency, sweep time, and power level parameters are the same as those listed in Table 3-1 of the 682XXB/683XXB Operation Manual.

Figure 2-19 provides an example of a recommended sequence for programming a reset command. Using this command sequence ensures that all parameters and commands assume their preprogrammed state each time reset is desired.

Table 2-22. Resetting the 682XXB/683XXB GPIB Interface Circuits

Methods of Resetting GPIB Interface Circuits	Functions Affected	Default Conditions
1. Pressing the front panel menu RETURN TO LOCAL soft-key.	Bus Messages	Local Instrument state does not change.
2. Pressing the front panel System menu RESET soft-key.	Service Request Modes	ES0, FB0, PE0, SB0, SE0, SQ0, UL0, SB0 GTS Local and Local Lockout
3. Sending the RST command over the bus.	Same as 2 above	Same as 2 above except that the local bus message is not reset.
4. Executing the interface message Device Clear.	Same as 2 above.	Same as 2 above except that the local bus message is not reset.
5. Turning power on and off.	Same as 2 above.	Places the GPIB into the power-on state. Instrument state does not change.

Sample Coding In Basic

```
10 CLEAR 705
20 OUTPUT 705; "FUL IL1 L1 10DM"
```

Explanation of Code

Line 10 sends the Device Clear bus message.This message clears the signal generator GPIB interface.

Line 20 sends new front panel settings: Full Sweep, Internal Leveling, and Output Power Level of 10 dBm.

Figure 2-19. *Reset Programming Example*

2-24 PROGRAMMING EXAMPLES

Figures 2-20 thru 2-22, on the following pages, provide three examples of GPIB programming using 682XXB/683XXB command codes.

The following subroutine uses the output identify (OI) command to identify the signal generator's model number, serial number, minimum and maximum frequencies, minimum and maximum power level, and software revision level. This subroutine is used in the example programs in Figures 2-21 and 2-22 to read the limits of the signal generator.

```
 10 !   "GET OI"
 20 ! Gets the output id string
 30 ! from a 68XXXX Signal Generator
100 OUTPUT 705; "OI"
110 DIM A$[36]
120 ENTER 705; A$
130 M$=A$[1,2] ! Model
140 M1$=A$[3,4] ! Model Number
150 F1$=A$[5,9] ! Freq Low
160 F2$=A$[10,14] ! Freq High
170 L2$=A$[15,20] ! Min Power
180 L1$=A$[21,24] ! Max Power
190 S$=A$[25,28] ! Software Ver
200 S1$=A$[29,34] ! Serial Number
210 P$=A$[35,35] ! Model Prefix
220 S2$=A$[36] ! Series
230 PRINT "Model Number :";M$;S2$;M1$;P$
240 PRINT "Serial Number :";S1$
250 PRINT "Low Freq :";F1$
260 PRINT "High Freq :";F2$
270 PRINT "Max Power :";L1$
280 PRINT "Min Power :";L2$
290 PRINT "Software Ver :";S$
300 END
```

Program Explanation

Line 100: Sends the "OI" command.
Line 110: Dimensions the variable.
Line 120: Gets the "OI" string.
Line 130: Sets M$ to the model (68).
Line 140: Sets M1$ to the model number.
Line 150: Sets F1$ to the signal generator low-end frequency.
Line 160: Sets F2$ to the signal generator high-end frequency.
Line 170: Sets L2$ to the minimum power point.
Line 180: Sets L1$ to the maximum power point.
Line 190: Sets S$ to the software version number.
Line 200: Sets S1$ to the serial number.
Line 210: Sets P$ to the model prefix number (2 or 3).
Line 220: Sets S2$ to the model series (A or B).
Lines 230-290: Prints the data obtained.

Figure 2-20. *Using the Output Identify (OI) Command*

The following program (1) receives entries from the keyboard to set intial frequency and step-size parameters, and (2) activates the soft keys on the controller so that they can step the frequency up or down.

```
 20 ! PARAMETER ENTRY, SYZ, UP, AND DN COMMANDS
 30 Address=705
 40 CALL Iddev(Address,Model,Fmin,Fmax,Pmin,Pmax)
 50 OFF KEY
 60 DISP "ENTER FREQUENCY IN GHz";
 70 INPUT Freq
 80 IF Freq>Fmax OR Freq<Fmin THEN
 90   DISP "FREQUENCY OUT OF RANGE - ";
100   GOTO 60
110 END IF
120 DISP "ENTER STEP SIZE IN GHz";
130 INPUT Stepsize
140 IF Stepsize>Fmax-Fmin OR Stepsize<.000001 THEN
150   DISP "ILLEGAL STEP SIZE - ";
160   GOTO 120
170 END IF
180 OUTPUT Address;"CF1";Freq;"GH SYZ";Stepsize;"GH"
190 ON KEY 0 LABEL "STEP" GOTO 300
200 ON KEY 5 LABEL " UP " GOTO 300
210 ON KEY 1 LABEL "STEP" GOTO 320
220 ON KEY 6 LABEL "DOWN" GOTO 320
230 ON KEY 2 LABEL "NEW " GOTO 50
240 ON KEY 7 LABEL "FREQ" GOTO 50
250 GOTO 250
300 OUTPUT Address;"UP"
310 GOTO 250
320 OUTPUT Address;"DN"
330 GOTO 250
340 END
1010 SUB Iddev(Address,Model,Fmin,Fmax,Pmin,Pmax)
1020 DIM Ident$[36]
1030 OUTPUT Address;"OI"
1040 ENTER Address;Ident$
1050 Model=VAL(Ident$[1,2])
1060 Model Number=VAL(Ident$[3,4])
1070 Fmin=VAL(Ident$[5,9])
1080 Fmax=VAL(Ident$[10,14])
1090 Pmin=VAL(Ident$[15,20])
1100 Pmax=VAL(Ident$[21,24])
1110 Model Prefix=Ident$[35,35]
1120 Series=VAL(Ident$[36])
1130 SUBEND
```

Program Explanation

Line 30: Sets the address of the signal generator.
Line 40: Calls the device identification subroutine described in Line 1010.
Line 50: Turns off the key definitions.
Lines 60-110: Accept the starting frequency entry and checks its validity.
Lines 120-170: Accept the step size entry and checks its validity.
Line 180: Sets the signal generator to the starting frequency and step size.
Lines 190-240: Set up keys and key labels.
Line 250: Waits for a key to be pressed.
Line 300: Reports that the STEP UP key was pressed; sends the UP command.
Line 310: Waits for the next key.
Line 320: Reports that the STEP DOWN key was pressed; send the DN command.
Line 330: Waits for the next key.
Line 340: Ends the main program.
Lines 1010-1120: Identify the signal generator address, model, frequency range, and power range.

Figure 2-21. *Controlling CW Frequency/Parameter Entries*

The following program accepts user inputs for (1) power sweep starting and ending levels, (2) number of steps in the sweep, and (3) sweep dwell times. After accepting such imputs, the program then commands the signal generator to obtain a display of the power sweep.

NOTE: The signal generator should be connected to a scalar network analyzer.

```
 30 Address=705
 40 CALL Iddev(Address,Model,Fmin,Fmax,Pmin,Pmax)
 60 DISP "ENTER POWER SWEEP STARTING LEVEL (dBm)";
 70 INPUT Powerstart
 80 IF Powerstart>Pmax OR Powerstart<Pmin THEN
 90   DISP "POWER OUT OF RANGE - ";
100   GOTO 60
110 ENDIF
120 DISP "ENTER POWER SWEEP ENDING LEVEL (dBm)";
130 INPUT Powerstop
140 IF Powerstop>Pmax OR Powerstop<Pmin THEN
150   DISP "POWER OUT OF RANGE - ";
160   GOTO 120
170 END IF
180 DISP "ENTER NUMBER OF STEPS";
190 INPUT Noofsteps
200 IF Noofsteps<1 OR Noofsteps>10000 THEN
210   DISP "NUMBER OF STEPS OUT OF RANGE - ";
220   GOTO 180
230 END IF
240 DISP "ENTER DWELL TIME AT EACH STEP (mS)";
250 INPUT Dwell
260 IF Dwell<1 OR Dwell>99000 THEN
270   DISP "DWELL TIME OUT OF RANGE - ";
280   GOTO 240
290 END IF
300 OUTPUT Address;"L1";Powerstart:"DM L2";Powerstop;
    "DM PNS";Noofsteps;"SPS"
310 OUTPUT Address;"PDT";Dwell;"MS LSP"
340 END
1010 SUB Iddev(Address,Model,Fmin,Fmax,Pmin,Pmax)
1020 DIM Ident$[36]
1030 OUTPUT Address;"OI"
1040 ENTER Address;Ident$
1050 Model=VAL(Ident$[1,2])
1060 Model Number=VAL(Ident$[3,4])
1070 Fmin=VAL(Ident$[5,9])
1080 Fmax=VAL(Ident$[10,14])
1090 Pmin=VAL(Ident$[15,20])
1100 Pmax=VAL(Ident$[21,24])
1110 Model Prefix=Ident$[35,35]
1120 Series=VAL(Ident$[36])
1130 SUBEND
```

Program Explanation

Line 30: Set the address of the signal generator.
Line 40: Call the device identification subroutine described in line 1010.
Lines 60-110: Accept the starting power level entry and checks its validity.
Lines 120-170: Accept the ending power level entry and checks its validity.
Lines 180-230: Accept the power sweep number-of-steps entry and checks it validity.
Lines 240-290: Accept the power sweep dwell time entry and checks its validity.
Lines 300-310: Sets the signal generator to perform the above defined power sweep.
Line 340: Ends the main program.
Lines 1010-1120: Identify the signal generator address, model, frequency range, and power range.

Figure 2-22. *Controlling Power Level and Power Sweep*

Appendix A
Index of GPIB Commands

A-1 INTRODUCTION

This appendix provides an alphabetical index of the GPIB Product Specific Commands for the 682XXB/683XXB. The index lists the command mnemonic code, a brief description of the command function, and the page number in Chapter 2 where a complete description of the command can be found.

GPIB Commands (1 of 15)

Command Code	Function	Page Number
ACW	Activates currently scanned frequency as CW	2-16
AD1	Selects F1-ΔF alternate sweep	2-19
AD5	Selects F5-ΔF alternate sweep	2-19
AD6	Selects F6-ΔF alternate sweep	2-19
ADD	Opens the GPIB address parameter	2-70
ADP1	Opens the internal AM % depth parameter	2-9
ADP2	Opens the internal AM dB depth parameter	2-9
ADR	GPIB address terminator	2-14
AF1	Selects F1-F2 alternate sweep	2-19
AF3	Selects F3-F4 alternate sweep	2-19
AFU	Selects Full Range alternate sweep	2-19
AL0	Set alternate sweep RF output level to L0	2-25
AL1	Set alternate sweep RF output level to L1	2-25
AL2	Set alternate sweep RF output level to L2	2-25
AL3	Set alternate sweep RF output level to L3	2-25
AL4	Set alternate sweep RF output level to L4	2-25
AL5	Set alternate sweep RF output level to L5	2-25
AL6	Set alternate sweep RF output level to L6	2-25
AL7	Set alternate sweep RF output level to L7	2-25
AL8	Set alternate sweep RF output level to L8	2-25
AL9	Set alternate sweep RF output level to L9	2-25
AM0	Turns off the internal or external AM function	2-33
AM1	Turns on the external AM function in Linear mode	2-33
AM2	Turns on the external AM function in Log mode	2-33
AM3	Selects front panel external AM input	2-33
AM4	Selects rear panel external AM input	2-33
AM5	Selects external AM input impedance of 50Ω	2-33

GPIB Commands (2 of 15)

Command Code	Function	Page Number
AM6	Selects external AM input impedance of 600Ω	2-33
AM7	Turns on the internal AM function in Linear mode	2-33
AM8	Turns on the internal AM function in Log mode	2-33
AMI	Turns on the AM Measurement mode	2-39
AMR	Opens the internal AM rate parameter	2-9
AMS	Opens the external AM %/V sensitivity parameter	2-10
AMW(x)	Selects the internal AM waveform, where x = 1-sine wave, 2-square wave, 3-positive ramp, 4-negative ramp, 5-Gaussian noise, 6-uniform noise, 7-triangle wave	2-33
ASD	Opens the external AM dB/V sensitivity parameter	2-10
AT0	Deselects step attenuator decouple mode	2-27
AT1	Selects step attenuator decouple mode on	2-27
ATT(xx)	Sets step attenuator value to xx (×10 dB) in ALC step attenuator decouple mode. xx is an unsigned integer between 00 and 11.	2-27
AUT	Selects Auto sweep trigger	2-19
BPN	Selects –5V for retrace and bandswitch blanking outputs	2-52
BPP	Selects +5V for retrace and bandswitch blanking outputs	2-52
CF0	Set CW mode at F0, Opens F0 parameter	2-16
CF1	Set CW mode at F1, Opens F1 parameter	2-16
CF2	Set CW mode at F2, Opens F2 parameter	2-16
CF3	Set CW mode at F3, Opens F3 parameter	2-16
CF4	Set CW mode at F4, Opens F4 parameter	2-16
CF5	Set CW mode at F5, Opens F5 parameter	2-16
CF6	Set CW mode at F6, Opens F6 parameter	2-16
CF7	Set CW mode at F7, Opens F7 parameter	2-16
CF8	Set CW mode at F8, Opens F8 parameter	2-16
CF9	Set CW mode at F9, Opens F9 parameter	2-16
CLO	Closes the open parameter	2-13
CLR	Clears data entry	2-13
CM0	Set CW mode at M0, Opens M0 parameter	2-16
CM1	Set CW mode at M1, Opens M1 parameter	2-16
CM2	Set CW mode at M2, Opens M2 parameter	2-16
CM3	Set CW mode at M3, Opens M3 parameter	2-16
CM4	Set CW mode at M4, Opens M4 parameter	2-16
CM5	Set CW mode at M5, Opens M5 parameter	2-16
CM6	Set CW mode at M6, Opens M6 parameter	2-16
CM7	Set CW mode at M7, Opens M7 parameter	2-16
CM8	Set CW mode at M8, Opens M8 parameter	2-16

GPIB Commands (3 of 15)

Command Code	Function	Page Number
CM9	Set CW mode at M9, Opens M9 parameter	2-16
CS0	Turns off the CW ramp	2-70
CS1	Turns on the CW ramp	2-70
CSB	Clears all GPIB status bytes	2-50
D1	Opens the internal pulse delay1 parameter	2-11
D2	Opens the internal pulse delay2 parameter	2-11
D3	Opens the internal pulse delay3 parameter	2-11
D4	Opens the internal pulse delay4 parameter	2-11
DB	dB data terminator	2-14
DF0	Selects the F0-ΔF sweep mode	2-19
DF1	Selects the F1-ΔF sweep mode	2-19
DF5	Selects the F5-ΔF sweep mode	2-19
DF6	Selects the F6-ΔF sweep mode	2-19
DFF	Opens the ΔF parameter (Same as DLF)	2-8
DFM	Opens the ΔF parameter (Same as DLF)	2-8
DL1	Selects external detector leveling of the output power	2-26
DLF	Opens the ΔF parameter	2-8
DM	dBm data terminator	2-14
DN	Decrements the open parameter by the step size	2-13
DPT	Internal triggered pulse with delay	2-37
DS0	Turns on the secure mode (Blanks the front panel display of Frequency, Power Level, and Modulation parameters)	2-70
DS1	Turns off the secure mode and restores front panel display of all parameters	2-70
DU0	Deselects Dual Step sweep mode	2-19
DU1	Selects Dual Step sweep mode on	2-19
DV	Decibel/Volt (dB/V) terminator	2-14
EGI	Opens the Reference Level DAC setting parameter (in external power leveling mode)	2-12
EGO	Outputs the value of the Reference Level DAC	2-26
ELF	Selects front panel external leveling input	2-26
ELR	Selects rear panel external leveling input	2-26
EL0	Inhibits updating of the ESB2 bit 4 (RF Unlocked)	2-50
EL1	Enables updating of the ESB2 bit 4 (RF Unlocked)	2-50
EP0	Selects TTL-low to turn RF on during pulse modulation	2-52
EP1	Selects TTL-high to turn RF on during pulse modulation	2-52
ES0	Inhibits End-of-Sweep SRQ generation	2-49
ES1	Enables End-of-Sweep SRQ generation	2-49
EXT	Selects single sweep trigger	2-19

GPIB Commands (4 of 15)

Command Code	Function	Page Number
F0	Opens the F0 parameter	2-8
F1	Opens the F1 parameter	2-8
F2	Opens the F2 parameter	2-8
F3	Opens the F3 parameter	2-8
F4	Opens the F4 parameter	2-8
F5	Opens the F5 parameter	2-8
F6	Opens the F6 parameter	2-8
F7	Opens the F7 parameter	2-8
F8	Opens the F8 parameter	2-8
F9	Opens the F9 parameter	2-8
FB0	Inhibits Extended Status Byte 1 SRQ generation	2-49
FB1	Enables Extended Status Byte 1 SRQ generation	2-49
FDV	Opens the internal FM deviation parameter	2-10
FM0	Turns off the internal or external FM function	2-33
FM1	Turns on the external FM function in Unlocked Narrow mode	2-34
FM2	Turns on the external FM function in Locked Low-Noise mode	2-34
FM3	Selects front panel external FM input	2-34
FM4	Selects rear panel external FM input	2-34
FM5	Selects external FM input impedance of 50Ω	2-34
FM6	Selects external FM input impedance of 600Ω	2-34
FM7	Turns on the internal FM function in Unlocked Narrow mode	2-34
FM8	Turns on the internal FM function in Unlocked Wide mode	2-34
FM9	Turns on the internal FM function in Locked mode	2-34
FMD	Turns on the FM Measurement mode	2-39
FML	Turns on the external FM function in Locked mode	2-35
FMN	Turns on the internal FM function in Locked Low-Noise mode	2-34
FMR	Opens the internal FM rate parameter	2-10
FMS	Opens the external FM sensitivity parameter	2-10
FMU	Turns on the external FM function in Unlocked Narrow mode (Same as FM1)	2-35
FMW	Turns on the external FM function in Unlocked Wide mode	2-34
FRS	Opens the frequency scaling reference multiplier parameter	2-52
FUL	Selects the Full Range sweep mode	2-19

GPIB Commands (5 of 15)

Command Code	Function	Page Number
FWV(x)	Selects the internal FM waveform, where x = 1-sine wave, 2-square wave, 3-positive ramp, 4-negative ramp, 5-Guassian noise, 6-uniform noise, 7-triangle wave	2-35
GH	GHz data terminator	2-14
GP	Internal gated pulse on	2-37
GTC	Scans to the next higher preset CW frequency on a GET (Executes a "SQF" command)	2-54
GTD	Steps the open parameter down by the step size on a GET (Executes a "DN" command)	2-54
GTF	Executes a Fast-frequency-switching step on a GET (See "ZL, ZEL" commands)	2-54
GTL	Steps to the next point in a dual step sweep mode on a GET (Executes a "TSS" command)	2-54
GTO	Disables the GET functions	2-54
GTS	Triggers a single sweep on a GET (Executes a "TRS" command)	2-54
GTT	Executes a complete signal generator self test on a GET (Executes a "TST" command)	2-54
GTU	Steps the open parameter up by the setp size on a GET (Executes an "UP" command)	2-54
GV	GHz per volt (GHz/V) data terminator	2-14
HZ	Hz data terminator	2-14
*IDN?	Outputs the instrument identification string	2-36
II0	Enables updating of the ESB2 bit 7 (Parameter Changed)	2-50
II1	Inhibits updating of the ESB2 bit 7 (Parameter Changed)	2-50
IL1	Selects internal leveling of the output power	2-25
IP	Turns on internal pulse modulation	2-36
IM1	Turns on the Intensity marker mode	2-23
KH	kHz data terminator	2-14
KV	kHz per volt (kHz/V) data terminator	2-14
L0	Sets RF output power level to L0	2-25
L1	Sets RF output power level to L1	2-25
L2	Sets RF output power level to L2	2-25
L3	Sets RF output power level to L3	2-25
L4	Sets RF output power level to L4	2-25
L5	Sets RF output power level to L5	2-25
L6	Sets RF output power level to L6	2-25
L7	Sets RF output power level to L7	2-25
L8	Sets RF output power level to L8	2-25
L9	Sets RF output power level to L9	2-25
LE0	Inhibits Lock Error SRQ generation	2-49

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Command Code	Function	Page Number
LE1	Enables Lock Error SRQ generation	2-49
LOS	Opens the level offset parameter	2-9
LO0	Turns off the Level Offset function	2-25
LO1	Turns on the Level Offset function	2-25
LS0	Inhibits updating of the ESB1 bit 3 (RF Locked)	2-50
LS1	Enables updating of the ESB1 bit 3 (RF Locked)	2-50
LSP	Selects the Power Sweep mode	2-26
LUR	Readies the 682XXB/683XXB to receive five tables of user level calibration data from the controller.	2-59
LUS	Sends all five tables of user level calibration data to the controller.	2-59
LU0	Turns off the active user level calibration table	2-59
LU1	Activates user level calibration table #1	2-59
LU2	Activates user level calibration table #2	2-59
LU3	Activates user level calibration table #3	2-59
LU4	Activates user level calibration table #4	2-59
LU5	Activates user level calibration table #5	2-59
LV0	Turns off leveling of the output power	2-26
M0	Opens the M0 parameter	2-8
M1	Opens the M1 parameter	2-8
M2	Opens the M2 parameter	2-8
M3	Opens the M3 parameter	2-8
M4	Opens the M4 parameter	2-8
M5	Opens the M5 parameter	2-8
M6	Opens the M6 parameter	2-8
M7	Opens the M7 parameter	2-8
M8	Opens the M8 parameter	2-8
M9	Opens the M9 parameter	2-8
MAN	Selects manual (step) sweep	2-19
MB0	Sets the enable mask byte for the Primary Status Byte	2-49
MB1	Sets the enable mask byte for Extended Status Byte 1	2-49
MB2	Sets the enable mask byte for Extended Status Byte 2	2-49
ME0	Disables the marker at the active frequency	2-23
ME1	Enables a marker at the active frequency	2-23
MH	MHz data terminator	2-14
MK0	Turns off markers	2-23
MOM	Turns off the AM and FM measurement modes	2-39
MS	Milliseconds (ms) data terminator	2-14
MV	MHz per volt (MHz/V) data terminator	2-14

GPIB Commands (7 of 15)

Command Code	Function	Page Number
NS	Nanoseconds (ns) data terminator	2-14
OAB	Returns the external AM sensitivity value (in dB/V) to the controller	2-42
OAD1	Returns the internal AM depth value (in %) to the controller	2-41
OAD2	Returns the internal AM depth value (in dB) to the controller	2-42
OAE	Returns the name of the AM source ("FRONT", "REAR", "INTERNAL") to the controller	2-42
OAI	Returns the external AM impedance value (in Ω) to the controller	2-42
OAR	Returns the internal AM rate (in Hz) to the controller	2-42
OAS	Returns the external AM sensitivity value (in %/V) to the controller	2-42
OAW	Returns the name of the internal AM waveform ("SINE", "SQUARE WAVE", "RAMP UP", "RAMP DOWN", "GAUSSIAN NOISE", "UNIFORM NOISE", "TRIANGLE") to the controller	2-42
OD1	Returns the internal pulse delay1 value (in μs) to the controller	2-43
OD2	Returns the internal pulse delay2 value (in μs) to the controller	2-43
OD3	Returns the internal pulse delay3 value (in μs) to the controller	2-43
OD4	Returns the internal pulse delay4 value (in μs) to the controller	2-43
ODD	Returns the internal pulse stepped delay mode step size value (in μs) to the controller	2-43
ODE	Returns the internal pulse stepped delay mode delay 1 stop value (in μs) to the controller	2-43
ODF	Returns the ΔF frequency value (in MHz) to the controller	2-43
ODL	Returns the internal pulse stepped delay mode dwell-time-per-step value (in ms) to the controller	2-43
ODP	Returns the internal pulse delay1 value (in μs) to the controller (Same as OD1)	2-43
ODS	Returns the internal pulse stepped delay mode delay 1 start value (in μs) to the controller	2-43
OEM	Returns the Extended SRQ Mask bytes (3 binary bytes) to the controller	2-44
OES	Returns all three GPIB status bytes to the controller	2-44
OF0	Returns the F0 frequency value (in MHz) to the controller	2-40
OF1	Returns the F1 frequency value (in MHz) to the controller	2-40
OF2	Returns the F2 frequency value (in MHz) to the controller	2-40
OF3	Returns the F3 frequency value (in MHz) to the controller	2-40
OF4	Returns the F4 frequency value (in MHz) to the controller	2-40

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Command Code	Function	Page Number
OF5	Returns the F5 frequency value (in MHz) to the controller	2-40
OF6	Returns the F6 frequency value (in MHz) to the controller	2-40
OF7	Returns the F7 frequency value (in MHz) to the controller	2-40
OF8	Returns the F8 frequency value (in MHz) to the controller	2-40
OF9	Returns the F9 frequency value (in MHz) to the controller	2-40
OFD	Returns the internal FM deviation value (in Hz) to the controller	2-42
OFE	Returns the name of the FM source ("FRONT", "REAR", "INTERNAL") to the controller	2-42
OFH	Returns the high-end frequency value (in MHz) to the controller	2-40
OFI	Returns the external FM impedance value (in Ω) to the controller	2-42
OFK	Returns the internal or external FM lock status, "UNLOCKED NARROW", "UNLOCKED WIDE", "LOCKED" to the controller	2-42
OFL	Returns the low-end frequency value (in MHz) to the controller	2-40
OFR	Returns the internal FM rate (in Hz) to the controller	2-42
OFS	Returns the external FM sensitivity value (in MHz/V) to the controller	2-42
OFW	Returns the name of the internal FM waveform ("SINE", "SQUARE WAVE", "RAMP UP", "RAMP DOWN", "GAUSSIAN NOISE", "UNIFORM NOISE", "TRIANGLE") to the controller	2-42
OI	Returns the instrument identification string to the controller	2-40
OL0	Returns the L0 power level value (in dBm) to the controller	2-41
OL1	Returns the L1 power level value (in dBm) to the controller	2-41
OL2	Returns the L2 power level value (in dBm) to the controller	2-41
OL3	Returns the L3 power level value (in dBm) to the controller	2-41
OL4	Returns the L4 power level value (in dBm) to the controller	2-41
OL5	Returns the L5 power level value (in dBm) to the controller	2-41
OL6	Returns the L6 power level value (in dBm) to the controller	2-41
OL7	Returns the L7 power level value (in dBm) to the controller	2-41
OL8	Retruns the L8 power level value (in dBm) to the controller	2-41

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Command Code	Function	Page Number
OL9	Returns the L9 power level value (in dBm) to the controller	2-41
OLO	Retruns the Level Offset power level (in dB) to the controller	2-41
OM0	Returns the M0 frequency value (in MHz) to the controller	2-40
OM1	Returns the M1 frequency value (in MHz) to the controller	2-40
OM2	Returns the M2 frequency value (in MHz) to the controller	2-40
OM3	Returns the M3 frequency value (in MHz) to the controller	2-40
OM4	Returns the M4 frequency value (in MHz) to the controller	2-40
OM5	Returns the M5 frequency value (in MHz) to the controller	2-42
OM6	Returns the M6 frequency value (in MHz) to the controller	2-42
OM7	Returns the M7 frequency value (in MHz) to the controller	2-42
OM8	Returns the M8 frequency value (in MHz) to the controller	2-42
OM9	Returns the M9 frequency value (in MHz) to the controller	2-42
OMD	Returns the name of the internal pulse mode ("SINGLE", "DOUBLET", "TRIPLET", "QUADRUPLET") to the controller	2-43
OMM	1. Returns the AM depth measurement value (in %) to the controller, when the AMI command either has been or is also programmed. 2. Returns the FM deviation measurement value (in MHz) to the controller, when the FMD command either has been or is also programmed.	2-44
OP3	Returns the name of the pulse source ("FRONT", "REAR", "INTERNAL FRONT TRIG", "INTERNAL REAR TRIG") to the controller	2-44
OP5	Returns the internal or external pulse polarity ("HIGH", "LOW") to the controller	2-44
OPC	Returns the internal pulse clock rate (in MHz) to the controller	2-43
OPD	Returns the power sweep dwell time (in ms) to the controller	2-41
OPHD	Returns the internal ΦM deviation value (in radians) to the controller	2-42
OPHE	Returns the name of the ΦM source ("FRONT", "REAR", "INTERNAL") to the controller	2-43
OPHI	Returns the external ΦM impedance value (in Ω) to the controller	2-43
OPHM	Returns the name of the ΦM mode ("NARROW", "WIDE") to the controller	2-43
OPHR	Returns the internal ΦM rate (in Hz) to the controller	2-42
OPHS	Returns the external ΦM sensitivity value (in radians/V) to the controller	2-43

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Command Code	Function	Page Number
OPHW	Returns the name of the internal FM waveform ("SINE", "SQUARE WAVE", "RAMP UP", "RAMP DOWN", "GAUSSIAN NOISE", "UNIFORM NOISE", "TRIANGLE") to the controller	2-42
OPM	Returns the internal power meter measurement (in dBm) to the controller	2-44
OPP	Returns the internal pulse period value (in μs) to the controller	2-43
OPR	Returns the internal pulse frequency (in MHz) to the controller	2-43
OPS	Returns the power sweep number of steps to the controller	2-41
OPT	Returns the name of the internal pulse trigger ("FREE RUN", "GATED", "DELAYED", "TRIGGERED", "TRIG WITH DELAY", "COMPOSITE") to the controller	2-44
OPW	Returns the internal pulse width1 value (in μs) to the controller (Same as OW1)	2-43
OSB	Retruns the Primary Status Byte (1 binary byte) to the controller	2-44
OSD	Returns the step sweep dwell time (in ms) to the controller	2-41
OSE	Returns the last GPIB syntax error to the controller	2-44
OSM	Returns the primary SRQ Mask byte (1 binary byte) to the controller	2-44
OSR	Returns the self-test results (6 binary bytes) to the controller	2-44
OSS	Returns the step sweep number of steps to the controller	2-42
OST	Returns the sweep time value (in ms) to the controller	2-42
OVN	Returns the ROM version number string to the controller	2-44
OW1	Returns the internal pulse width1 value (in μs) to the controller	2-43
OW2	Returns the internal pulse width2 value (in μs) to the controller	2-43
OW3	Returns the internal pulse width3 value (in μs) to the controller	2-43
OW4	Returns the internal pulse width4 value (in μs) to the controller	2-43
OWT	Returns the GPIB termination status to the controller (0 = CR, 1 = CRLF)	2-44
P0	Turns off the internal or external pulse modulation function	2-36
P3	Selects front panel external pulse input	2-37
P4	Selects rear panel external pulse input	2-37
PC1	Selects the 10 MHz internal pulse clock rate	2-37
PC4	Selects the 40 MHz internal pulse clock rate	2-37

GPIB Commands (11 of 15)

Command Code	Function	Page Number
PCT	Percent (%) data terminator	2-14
PCV	Percent per volt (%/V) data terminator	2-14
PDT	Opens the power sweep dwell time parameter	2-9
PDY	Opens the internal pulse delay1 parameter (Same as D1)	2-11
PE0	Inhibits Parameter Range Error SRQ generation	2-49
PE1	Enables Parameter Range Error SRQ generation	2-49
PER	Opens the internal pulse period parameter	2-11
PH0	Turns off the internal or external ΦM function	2-35
PH1	Turns on the external ΦM function in Narrow mode	2-35
PH2	Turns on the external ΦM function in Wide mode	2-35
PH3	Selects front panel external ΦM input	2-35
PH4	Selects rear panel external ΦM input	2-35
PH5	Selects external ΦM input impedance of 50Ω	2-35
PH6	Selects external ΦM input impedance of 600Ω	2-36
PH7	Turns on the internal ΦM function in Narrow mode	2-36
PH8	Turns on the internal ΦM function in Wide mode	2-36
PHD	Opens the internal ΦM deviation parameter	2-10
PHN	Turns on the external ΦM function in Narrow mode (Same as PH1)	2-36
PHR	Opens the internal ΦM rate parameter	2-10
PHS	Opens the external ΦM sensitivity parameter	2-10
PHV(x)	Selects the internal FM waveform, where x = 1-sine wave, 2-square wave, 3-positive ramp, 4-negative ramp, 5-Guassian noise, 6-uniform noise, 7-triangle wave	2-36
PHW	Turns on the external FM function in Wide mode (Same as PH2)	2-36
PL1	Selects external power meter leveling of the output power	2-26
PM0	Turns off the internal power meter measurement mode	2-39
PM1	Turns on the internal power meter measurement mode	2-39
PMD(x)	Selects the internal pulse mode, where x = 1-single, 2-doublet, 3-triplet, 4-quadruplet	2-37
PNS	Opens the power sweep number of steps parameter	2-9
PPO	Selects normally-open contacts on the pen lift relay	2-52
PPC	Selects normally-closed contacts on the pen lift relay	2-52
PR	Opens the internal pulse frequency parameter	2-11
PT0	Disables the Power Offset Table	2-56
PT1	Enables the Power Offset Table	2-56
PTC	Changes a Power Offset Table entry	2-56

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Command Code	Function	Page Number
PTF	Selects internal pulse triggering on the falling edge of an external input. Active only when pulse trigger is gated, triggered, or triggered with delay.	2-37
PTG(x)	Selects the internal pulse trigger, where x = 1-free run, 2-gated, 3-delayed, 4-triggered, 5-triggered with delay, 6-composite	2-37
PTL	Loads a Power Offset Table	2-56
PTR	Selects internal pulse triggering on the rising edge of an external input. Active only when pulse trigger is gated, triggered, or triggered with delay.	2-37
PVT	Opens the ALC power slope pivot point frequency parameter	2-12
PW	Opens the internal pulse width1 parameter (Same as W1)	2-11
RO0	Selects RF to be on at reset.	2-52
RO1	Selects RF to be off at reset.	2-52
RC0	Selects RF off during frequency switching in CW or step sweep modes	2-52
RC1	Selects RF on during frequency switching in CW or step sweep modes	2-52
RCF	Readies the 682XXB/683XXB to receive a new instrument setup from the controller	2-46
RCM	Readies the 682XXB/683XXB to receive a new instrument setup and new stored setups from the controller	2-46
RD	Radians data terminator	2-14
RF0	Turns off the RF output	2-25
RF1	Turns on the RF output	2-25
RL	Returns the instrument to local control	2-70
RSN(M_{1-9})	Recalls an instrument setup stored in internal setup memory location M, where M = 1 to 9.	2-46
RSS	Reset a sweep if in progress	2-19
RST	Resets the instrument to its default settings	2-70
RT0	Selects RF to be off during retrace	2-52
RT1	Selects RF to be on during retrace	2-52
RV	Radians per volt data terminator	2-14
S0	Turns off the Master-Slave mode of operation	2-67
S1	Turns on the Master-Slave mode of operation	2-67
SAF	Outputs the current instrument setup to the controller	2-46
SAM	Outputs the current instrument setup and all stored setups to the controller	2-46
SB0	Inhibits Extended Status Byte 2 SRQ generation	2-49
SB1	Enables Extended Status Byte 2 SRQ generation	2-49
SC0	Turns SCAN modulation function on	2-38

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Command Code	Function	Page Number
SC1	Turns SCAN modulation function off	2-38
SD0	Turns off the internal pulse stepped delay mode	2-37
SD1	Turns on the internal pulse stepped delay mode	2-37
SDD	Opens the internal pulse stepped delay mode step size parameter	2-11
SDE	Opens the internal pulse stepped delay mode delay 1 stop parameter	2-11
SDL	Opens the internal pulse stepped delay mode dwell-time-per-step parameter	2-12
SDS	Opens the internal pulse stepped delay mode delay 1 start parameter	2-12
SDT	Opens the step sweep dwell time parameter	2-9
SE0	Inhibits Syntax Error SRQ generation	2-50
SE1	Enables Syntax Error SRQ generation	2-49
SEC	Seconds data terminator	2-14
SF1	Selects the F1-F2 sweep mode	2-19
SF3	Selects the F3-F4 sweep mode	2-19
SLDF	Opens the ΔF parameter of the Slave unit	2-9
SLF0	Opens the F0 parameter of the Slave unit	2-8
SLF1	Opens the F1 parameter of the Slave unit	2-8
SLF2	Opens the F2 parameter of the Slave unit	2-8
SLF3	Opens the F3 parameter of the Slave unit	2-8
SLF4	Opens the F4 parameter of the Slave unit	2-8
SLF5	Opens the F5 parameter of the Slave unit	2-8
SLF6	Opens the F6 parameter of the Slave unit	2-8
SLF7	Opens the F7 parameter of the Slave unit	2-8
SLF8	Opens the F8 parameter of the Slave unit	2-8
SLF9	Opens the F9 parameter of the Slave unit	2-8
SLL1	Opens the main power level parameter (L1) for the Slave unit	2-12
SLL2	Opens the alternate sweep power level parameter (L2) for the Slave unit	2-12
SLM0	Opens the M0 parameter of the Slave unit	2-9
SLM1	Opens the M1 parameter of the Slave unit	2-9
SLM2	Opens the M2 parameter of the Slave unit	2-9
SLM3	Opens the M3 parameter of the Slave unit	2-9
SLM4	Opens the M4 parameter of the Slave unit	2-9
SLM5	Opens the M5 parameter of the Slave unit	2-9
SLM6	Opens the M6 parameter of the Slave unit	2-9
SLM7	Opens the M7 parameter of the Slave unit	2-9

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Command Code	Function	Page Number
SLM8	Opens the M8 parameter of the Slave unit	2-9
SLM9	Opens the M9 parameter of the Slave unit	2-9
SLP	Opens the ALC power slope value parameter	2-12
SL0	Turns off the ALC power slope function	2-26
SL1	Turns on the ALC power slope function	2-26
SLV	Opens the power level parameter for the Slave unit (Same as SLL1)	2-12
SM	Recalls the next stored instrument setup in sequence	2-46
SNR	Enter the instrument serial number (SNRnnnnnnX)	2-70
SNS	Opens the step sweep number of steps parameter	2-9
SOF	Opens the frequency offset parameter for the Slave unit	2-12
SPS	Steps data terminator	2-14
SP0	Deselects non-equally spaced step sweep	2-19
SP1	Selects non-equally spaced step sweep	2-19
SQ0	Disables the SRQ generation function	2-50
SQ1	Enables the SRQ generation function	2-50
SQD	Scan down to next lower preset CW frequency	2-16
SQF	Scan to next higher preset CW frequency	2-16
SQP	Turns on internal 1 kHz square wave pulse modulation	2-37
SQU	Scan up to next higher preset CW frequency	2-16
SSN(M_{1-9})	Saves the current instrument setup in internal setup memory location M, where M = 1 to 9	2-46
SSP	Selects step sweep	2-19
SW0	Turns off the internal or external pulse modulation function (Same as P0)	2-38
SW1	Turns on internal 400 Hz square wave pulse modulation	2-38
SW2	Turns on internal 1 kHz square wave pulse modulation (Same as SQP)	2-38
SW3	Turns on internal 7.8125 kHz square wave pulse modulation	2-38
SW4	Turns on internal 27.8 kHz square wave pulse modulation	2-38
SW5	Selects front panel external pulse input (Same as P3)	2-38
SW6	Selects rear panel external pulse input (Same as P4)	2-38
SWP	Selects analog sweep	2-19
SWT	Opens the analog sweep and CW ramp time parameter	2-9
SYZ	Opens the increment/decrement step size parameter	2-15
TMS	Times terminator	2-14
TR0	Sets 0 dB of attenuation when RF is switched off in units with a step attenuator (Option 2) installed.	2-52

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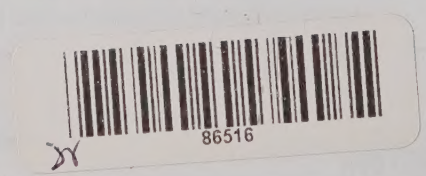
Command Code	Function	Page Number
TR1	Sets 40 dB (minimum) of attenuation when RF is switched off in units with a step attenuator (Option 2) installed.	2-52
TRG	Triggers a single sweep	2-19
TRS	Triggers a single sweep (Same as TRG)	2-19
TSS	Advances sweep to next step in dual step sweep mode	2-19
TST	Starts an instrument self-test	2-68
UL0	Inhibits RF Unleveled SRQ generation	2-50
UL1	Enables RF Unleveled SRQ generation	2-50
UP	Increment the open parameter by step size	2-12
US	Microseconds (μs) data terminator	2-14
VM1	Turns on the Video marker mode	2-23
W1	Opens the internal pulse width1 parameter	2-11
W2	Opens the internal pulse width2 parameter	2-11
W3	Opens the internal pulse width3 parameter	2-11
W4	Opens the internal pulse width4 parameter	2-11
XL0	Opens the L0 parameter	2-8
XL1	Opens the L1 parameter	2-8
XL2	Opens the L2 parameter	2-8
XL3	Opens the L3 parameter	2-8
XL4	Opens the L4 parameter	2-8
XL5	Opens the L5 parameter	2-8
XL6	Opens the L6 parameter	2-8
XL7	Opens the L7 parameter	2-8
XL8	Opens the L8 parameter	2-8
XL9	Opens the L9 parameter	2-8
XP	Turns on the external pulse modulation function	2-36
Y	Equivalent to a Group Excute Trigger (GET)	2-54
ZL($X_{000-999}$)	Loads a CW frequency into the stack at location X (fast-frequency-switching mode)	2-55
ZEL	Ends frequency loading (fast-frequency-switching mode)	2-55
ZS($X_{000-999}$)	Sets the stack pointer to point to location X (fast-frequency-switching mode)	2-55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